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A FRAMEWORK FOR SHARING COMMUNICATION MEDIA IN SUPPORTING CREATIVE TASK IN COLLABORATIVE WORKSPACE

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ABSTRACT

In networked collaborative working environment, users are involved with either repeatable or exclusive task. These variety tasks required the collaborative system to support it dynamic and creative solutions especially in sharing the communication media. Most of the related research is objectively focusing on the alignment of user behavior in shared activities. There is not much research conducted concerning on sharing communication media components in creative collaborative activity in details. In this paper, we analyze collaborative work application systems focusing on the communication module in four common areas; business, health, education and manufacturing. Based on the analysis, communication media sharing elements are formed into three layers. In each layer, media sharing element and its functions are identified. Then, we proposed a general software framework for communication media sharing for creative collaborative activities. The framework is functioning as a platform for users to manage their dynamic creative solutions to accomplish complex task.

Keywords: communication media, framework, creative task, collaboration, workspace.

INTRODUCTION

Globalization and changed in market trends emerged from the evolving of internet and communication technology. These trends contribute to the creating of new organizational structure and business sector to expand in remote areas. Currently, workers in Collaborative Working Environments (CWE) are composed of dynamic assemble groups from diverse professional skills that work together within shared Collaborative Working Environments (CWE) [1]. This new structure makes possible for dispersed experts matters and workers be connected to collaborate and accomplish business projects [2]. Hence, collaborative work breaks through the common concept of computer application by providing collective cooperative workspace for users.

Collaborative workspaces are also designed for unpredictable problems that need current workflow systems adapt to the changing environment [3]. In this situation, users need a system that can support their creative solution activities such as ad hoc communications and allow them to react accordingly. This kind of activities needs the system efficiently control the services between sustaining the space for user creativity and coordinating the resources [4]. Moreover, the content of resources involved in such activities might be changed. Hence, provisioning of new knowledge and data transformation needed to be coordinated efficiently. Furthermore, dispersed users in such collaborative activities are not sharing the same physical work environment. They are outside of sensory range of each other. Thus, communication technology plays a major role in supporting the information exchange and interaction between remote group of users by using available communication media (text, video, voice and etc.).

Since the communication is a central activity in any collaborative work, issues in communication became one of the ongoing challenges encounter by the group of users [5]. Moreover, most of the problems highlighted by researchers are associated to project-related task coordination, such as workflow management, access control and conflict management [6, 7]. Moreover, the solutions proposed by the researchers are to adhere the need of user behavior alignment on shared activities and resources. In this context, communication media became utility tools with the predefined functions and fixed parameters. Hence, it is important for the systems to provide users with flexibilities to facilitate the sharing of communication media to support creative activities.

COLLABORATIVE WORKSPACE SYSTEM ARCHITECTURE

In designing the high-level system application architecture, most of the collaborative application systems embraced the layered design method. The ideology of this process is adopted from the network reference model; The Open Systems Interconnection (OSI) Model [8]. This model consists of seven layers. From the top to bottom are; application, presentation, session, transport, network, data-link and physical layers. Each layer has its own functions that categorized by a set of standard protocols. It receives information from the above layer and pass it to the next layer based on their hierarchy.

Classification of Layered Architecture Reference Model

There is three reference model that used by the researcher in designing the high-level collaborative application system architecture; *client/server model, N-level of distributed computing* and *web based application model* [9]. These reference models are the backbone of any communication between networked computers; mainly in collaborative work application systems. The

approach in designing collaborative frameworks that adopt these reference models can be classified into three categories: *service composition oriented, rule-based* [10] and *network technology driven*.

Service composition oriented: This approach utilizes services provided by the web services. The system allows multi-user to access central information and communicate each other through web services. The communication media between users are through chat tools, whiteboards, audio conferences and webcams. The web services language, *SOAP (Service Oriented Architecture Protocol)* and *WSDL (Web Services Description Language)* make the configuration of the communication capabilities more flexible. In order to support variety and rigid collaborative activities, services such as service abstraction, discovery and selection, placement and binding services [11] based on *Service Oriented Architecture* (*SOA)* is applied. Most of these services are associated in the middleware of the framework [12, 13]. However, these useful services have to comply with the well-defined rules in a specific domain problem.

Rule-based: This approach defines rules to control the behavior of services, users, resources and application in a collaborative environment [10]. This technique allows the system environment to provide flexible features for configuration, operation and creation of supporting services. In the context of communication media, synchronization rules are enforced to maintain the harmony of the collaborative environment.

Network technology driven: This approach deals with the components and logical entities of the network. It utilizes the advantages features and services provided by the technology. The approach is suitable for problem with well-defined problem scope and knowledge about tools supported by the network. This enables developers to reuse current techniques for dissimilar problems. Activity such as interaction among users is supported by the pre-defined and established communication techniques of the chosen technology.

In summary, most of the reviewed architectures and framework of collaborative working application systems have four common elements in their communication module. The four elements are user interface, collaborative activities, software design method and network technology. Hence, based on the layered architecture design method, Figure-1 shows the general view of communication layers in the collaborative system. The communication is the main element in creating collaborative culture. Its allow user to create, update, change and delete shared artefact. As users are not sharing the same physical work, exchanging and sharing resources and information are infeasible without sharing the communication media.

In the next section, sharing communication media in three contextual domains will be explored in order to define the sharing components.

COMMUNICATION MEDIA SHARING ENTITIES

There are three uses of communication in collaborative work activities [1]. First, to assists groups of users in integrating and coordinating their work activities by deliberating their past, current and future work activities, Secondly, serves as a platform for user to share and exchange information. Finally, it is one of the tools to simulate and encourage new knowledge among the users.

Communication is not only about interaction among a group of users. It is also including several types of objects that need to be shared through various platforms and user interfaces. Hence, user interaction and object sharing in a networked collaborative working system are analyzed. Based on the four common areas (business, education, health and manufacturing), seven components involve in communication in collaborative work activities have been studied. The components are *user, communication channel, resources, software component, work activity*, *coordination method* and *shared services*. Table-1 shows the sharing communication media components in the existing system.

Each domain has its own approach of disseminating information to its end-users. These dislocated and dispersed users establish various kinds of communication relationships during collaborative activities. The relationship can be one-to-one, one-to-many and many-to-many [14] that can determine the level of communication between the users. Furthermore, user's profile; such as role, privacy setting and own objects to share are important features in coordinating rules on handling the sharing process.

The medium of communication in any work activities will determine the scope of the task supported by the system. The user interface and sharing method would become more complex when the activity used various types of communication media. Most of the systems pre-defined their communication media into standard operation. The credibility of the coordination techniques affects by this condition. In order to collaborate effectively, the systems should dynamically adapt changes in task-related activity environment. This is due to the nature of works in certain domains that required changes of communication media during the interaction. Furthermore, not all work activities in the domains are repeatable workflow (create, edit, delete, etc.). Some activities need user creativity in using the communication media to solve ad-hoc and important problems such as exception handling problem. This can be well supported if appropriate communication media can match with the user requirements dynamically.

Most of the work activities in the studied domains are supported by various kinds of shared resources. The resources can be report document, slides presentation, proposal, and architectural design, and image, audio or video files. Moreover, some of the objects are associated with special shared features such as special access control that tagged with selected users. The features are set by different methods that tailored to the solutions strategy. In fact, the success of the sharing process is

depending on the interaction and synchronization of user, resources and media communication elements.

Different organizations will have different objectives and activities with different input devices and network communication model. Therefore, in dealing with this heterogeneous communication architecture; software component act as an intermediary between the user and network devices play a vital role in giving seamless communication in the collaboration process. Application program interface (API), embedded software components, special purpose program or custom made, and toolkits are common software components that used by shared media applications. This component helps developers to create tools to ease users in their tasks especially group formation along with sharing activities that include managing access and security.

In summary, the formation of communication media sharing is made possible by five related entities; *context profile, sharing method, algorithm strategy, interaction protocol* and *shared objects*. These entities will embed in the software framework of the systems, particularly in the communication module. General software based frameworks for collaborative work system focusing on the communication module is depicted in Figure-2. The framework was mapped with common communication structure as shown in Figure-1 which divides the structure into three layers: *front-end, intermediate and back-end*.

The *front-end layer* act as an interface for user to interact with the systems; and a place where communication relationship establishes among the group of users. It also provides information about the user profile, communication media and work activity. In contrary, the *intermediate layer* is a place where the coordination method, interaction protocol and shared services work together to create the seamless sharing communication process. It is the place where the request of the user or systems are entertained and served harmoniously by the system. Then, the *back-end layer* is the place where the communication channel transforms the data technically to be transported to the assigned users.

CONCEPTUAL FRAMEWORK

Dynamic and creative collaborative activities

In any software development, developers programmed solutions to all foresee exception that could happen during the process. This is where the testing phase is crucial in software development methodology. All the possible errors are captured and user requirements are hard coded into the system after the user acceptance test phase is done. In collaborative work, it is crucial for the systems to provide a space for creative and knowledge intense processes like online meeting and report documentation [15]. The work activities always involve ad-hoc and short-based unique project that needs a different approach which cannot be mapped with a repeatable workflow solution. All the dynamic changes required during the runtime should be supported and adopt by the system. Therefore, the users should allow communicating and shared data in creative manners to support various kinds of activities by the groups, subgroups or individual in the collaborative work environments.

Proposed framework

The proposed framework (Figure-3) was conformed to the general communication framework for collaborative work structure (Figure-2) for creative activities with media sharing elements. Each user (client) has three logical layers: front-end layer, immediate layer and back-end layer that adapts to client/server reference model for the layered architecture. The front-end layer hosts the collaborative applications communication media such as chat, shared browser and whiteboard. It provides awareness and informs intercepting events (local and remote) to the next layer. It sends messages to the next layer once any work activity is initiated by the users.

The *intermediate layer* is the cornerstone of any collaborative work application, as it is a central of many important functions such as controlling consistency among users, detecting and overcome any arise conflict and controlling information exchange. The *event manager* is in charge of intercepting events including the objects and users involved. It passed the information related to the event to the session module to initiate and administer the session.

A *session manager* handles sessions, which represent shared workspace for users to collaborate. It responsible to create, maintain and terminate of any sessions among users. It maintains the user context profile and identified the session owner or moderator. The moderator invoked appropriate tools to coordinate activities and users in the session. All used objects in the session are handled by the data manager. The creative trigger mechanism will invoke special rules to allow users override administrator-defined policy especially regarding sharing policy. The *communication manager* will receive requests and information about the activities and transport it to the server for permission and further process.

Since the proposed framework is based on the client/server reference model; the server is acting like a central processor while clients are dealing with the user's request. Hence, components in the server are mirrored for clients intermediate layer components except the event manager that only have in the clients. It contains communication manager that responsible to receive any request from clients and in charge of the application's context profile. All messages received will be translated and pass to server session manager to take further action. The session manager will control and facilitate all services related to the activities include the shared objects, protocol and invoke composer engine to cater any creative collaborative activities. The composer engine will process user self-manager sharing permission policy and prepare a platform for users to manage the shared media and objects flexibly.

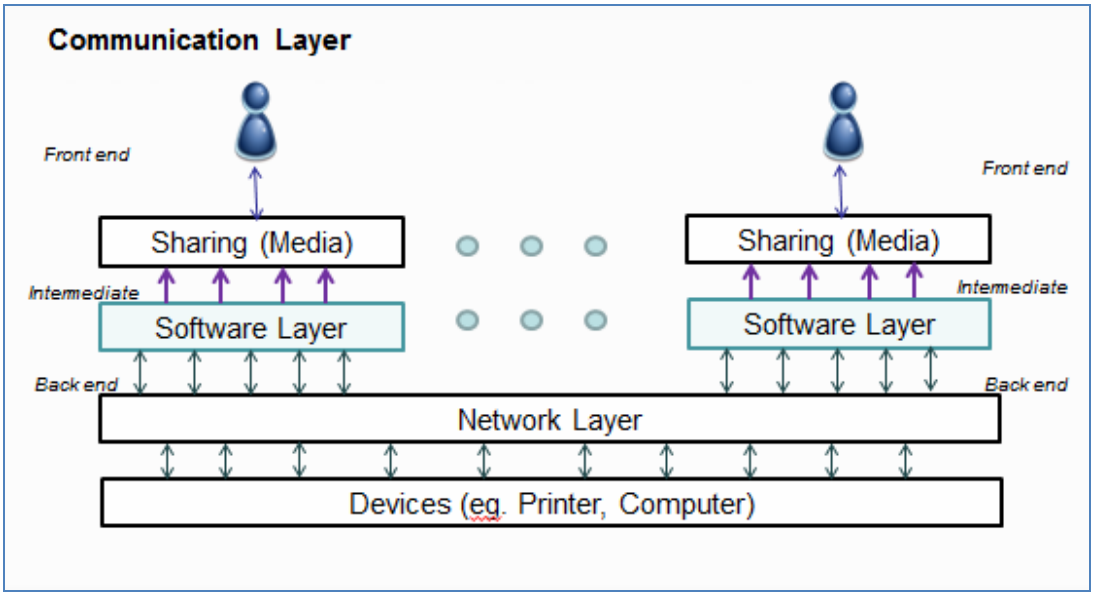

Figure-1. Summarization of communication layers [14].

Table-1. Sharing communication media components in selected domains.

Domain	Comm Channel	Type of Interaction	Coordination	Shared Resources	Shared Services	Context Profile	System Component
Business (Han & Kim, 2012), (Belen Pelegrina et.al 2010), (Cheaib et al, 2009)	Audio, video, chat, email	One to many, many to many, one to one,	event-based mechanism, agent-interaction protocol (agreed-on, request - response), rule-based	Documents, multimedia contents	paint	Roles, actions (context awareness), coordinate	mediator - service control, composable service, reusable and extended component
Education (El Saddik et al., 2008), (Bijlani et al, 2011)	Whiteboard, chat, audio, video, message	One to many, many to many, one to one,	JXTA protocol suit, distributed client/server module.	Web browser, telepointer, video, documents, graphics	web browser (IE, Mozilla)	role, name, access level	JXTA architecture, adaptive bitrate streaming methodology
Health (Ciampi et al,; 2010), (Dube et al, 2005)	Text, video	One to one	Rule paradigm, interaction protocol	multimedia objects, patients information, imaging	nil	name, medical record	Triggers mechanism, Agent-based infrastructure
Manufacturing (Sadeghi et al., 2010), (Mourtzis, 2011)	Text, chat, email	One to one, one to many	Product Process Organisation Module and meta rules, Model-view-controller pattern	designer drawing model, Planning Information, company schedule	nil	name, design copies, company name, production status, products availability	API. Web based technology

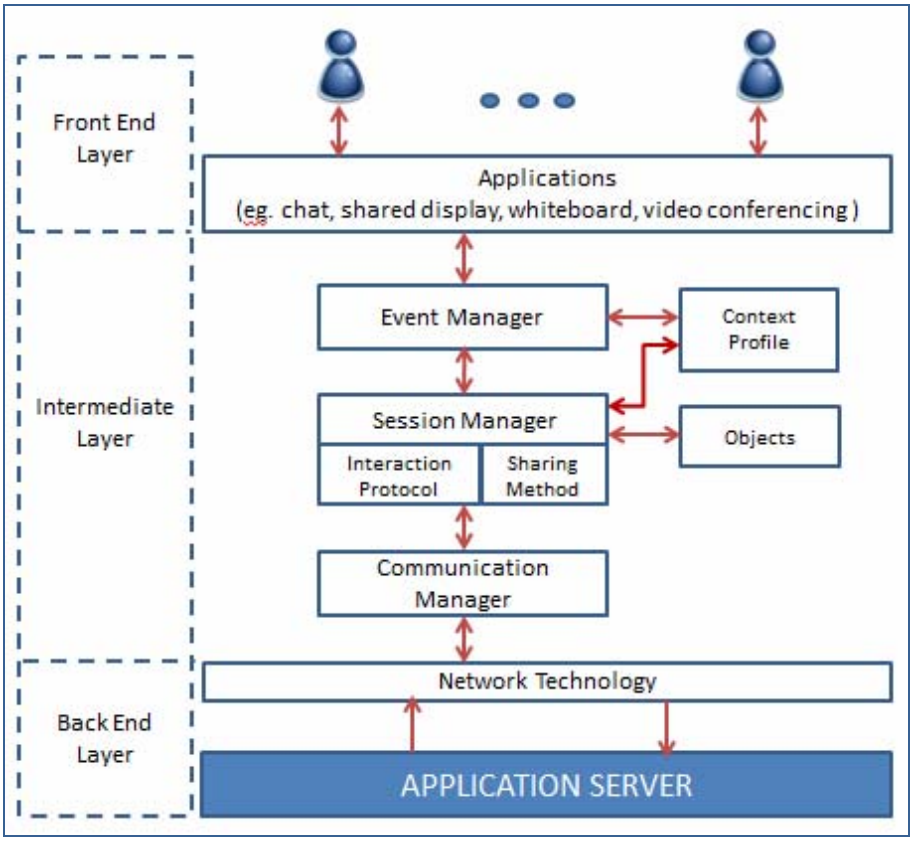

Figure-2. General communication framework in collaborative work.

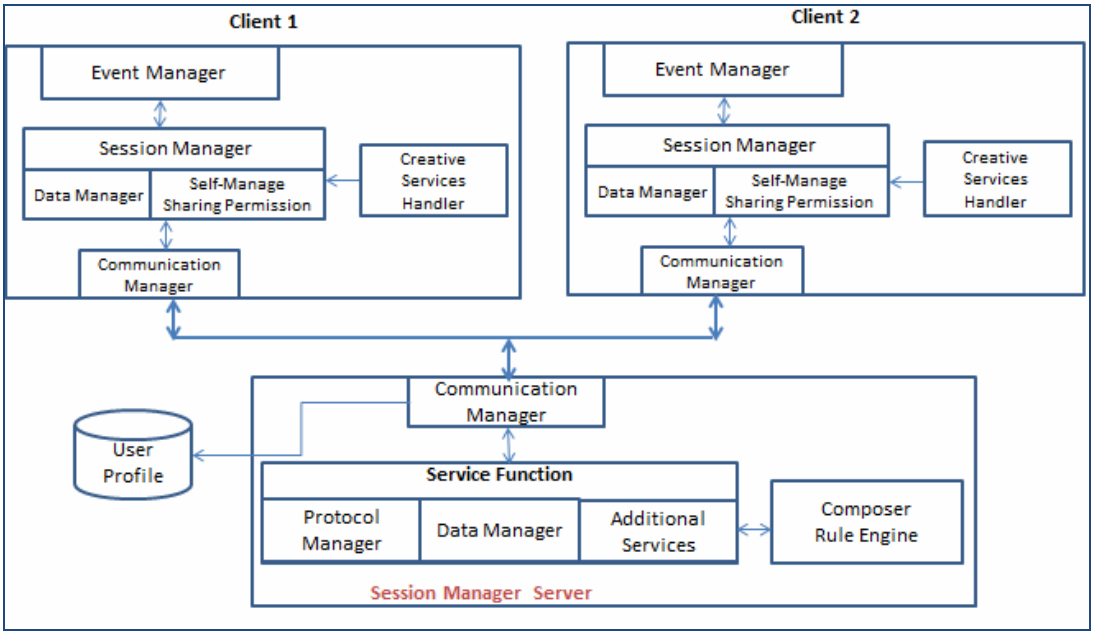

Figure-3. Communication media sharing framework for creative collaborative activity.

CONCLUSIONS

In this paper, detailed explanations are given about the high-level design architecture for collaborative work application systems that embrace the layered-design method which adopted from the OSI model. It also discussed the three approaches used in designing communication module in the system framework: service composition oriented, rule-based and network technology. Three main domains have been selected based on their active researcher contribution in this area. Based on these domains, seven important components have been identified: user, communication channel, resources, software component, work activity, coordination method and shared services. It also explains the importance of handling creative activity in the workspace and highlights the issues when dealing with the scattered users. Currently, most research proposed new approaches and techniques in their collaborative working environment. However, not much research interested in detail on communication media sharing components in creative collaborative activity. Hence, based on the analysis, we proposed a framework which represents the communication media sharing activity in the collaborative work. The software framework is functioning as a platform for users to dynamically manage the creative work activities. We left the media sharing compose engine functionality attributes and its constraints as one of future work for this research.

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REFERENCES

[1] M. Pallot, U. Bergmann, H. Kühnle, K. S. Pawar, and J. C. K. H. Riedel, "Collaborative Working Environments : Distance Factors Affecting Collaboration," in: Proceedings of the 16th International Conference on Concurrent Enterprising, ICE'2010. 2010.

[2] X. Xue, Q. Shen, H. Fan, H. Li, and S. Fan, "IT supported collaborative work in A/E/C projects: A ten-year review," Autom. Constr., vol. 21, pp. 1-9, January 2012.

[3] P. J. Kammer and R. N. Taylor, "Techniques for Supporting Dynamic and Adaptive Workflow," pp. 1-19, 2002.

[4] N. Schuster, C. Zirpins, S. Tai, S. Battle, and N. Heuer, "A Service-Oriented Approach to Document-Centric Situational Collaboration Processes," in 2009 18th IEEE International Workshops on Enabling Technologies: Infrastructures for Collaborative Enterprises, 2009, pp. 221-226.

[5] M. Bassanino, T. Fernando, and K.-C. Wu, "Can virtual workspaces enhance team communication and collaboration in design review meetings?" Archit. Eng. Des. Manag. pp. 1-18, March 2013.

[6] D. Sun, S. Xia, C. Sun, and D. Chen, "Operational Transformation for Collaborative Word Processing," In: Proceedings of the 2004 ACM conference on Computer supported cooperative work, 2004, vol. 6, no. 3, pp. 437-446.

[7] C. Jeffery, A. Dabholkar, K. Tachtevrenidis, and Y. Kim, "A Framework for Prototyping Collaborative Virtual Environments," Groupw. Des. Implementation, Use, pp. 17-32, 2005.

[8] B. Bielstein, "Computer Networks and Protocol - The OSI Reference Model," 2006. [Online]. Available: http://nsgn.net/osi_reference_model/the_osi_reference_model.htm. [Accessed: 16-Jul-2013].

[9] Q. Sun, Y. Qiu, W. Ma, and Y. Gu, "Collaborative Development of Network Application System Based on Layered Conceptual Model," 2010 2nd Int. Work. Database Technol. Appl., pp. 1-4, November 2010.

[10] S. W. Han and J. Kim, "A service composition oriented framework for configuring SMeet multiparty collaboration environments," Multimed. Tools Appl., March 2012.

[11] D. V. Jerstad, I. and Dustdar, S. and Thanh, "A Service Oriented Architecture Framework for Collaborative Services," in Enabling Technologies: Infrastructure for Collaborative Enterprise, 2005. 14th IEEE International Workshops on, 2005, pp. 121-125.

[12] D. G. Galatopoullos, D. N. Kalofonos, and E. S. Manolakos, "A P2P SOA enabling group collaboration through service composition," Proc. 5th Int. Conf. Pervasive Serv. - ICPS '08, p. 111, 2008.

[13] N. Kim, J. Kim, and T. Uram, "A hybrid multicast connectivity solution for multi-party collaborative environments," Multimed. Tools Appl., vol. 44, no. 1, pp. 17-37, 2009.

[14] N. Musa, S. Z. Z. Abidin, and N. Omar, "Towards flexible media sharing: Control and coordination issues in network collaborative virtual environment," 2012 IEEE Colloq. Humanit. Sci. Eng., no. Chuser, pp. 154-158, December 2012.

[15] N. Schuster, C. Zirpins, and U. Scholten, "How to balance flexibility and coordination? Service-oriented model and architecture for document-based collaboration on the Web," in: IEEE International Conference on Service-Oriented Computing and Applications (SOCA), 2011, pp. 1-9.