

An Adaptive Fault Tolerance Running on a Cloud Computing Environment

¹Soongohn Kim and ²Eungnam Ko (Corresponding Author)

¹*Department of Computer Science, Joongbu University, 101 Daehakro, Chubu-Meon, GumsanGun, Chungnam, 312-702, Korea*

²*Division of Information & Communication, Baekseok University, 115 Anseo-dong, Dongnam-gu, Cheonan, Chungnam, 330-704, Korea*

¹*sgkim@joongbu.ac.*, ²*ssken@daum.net*

Abstract

This paper explains the design of the AFT_CCE (an Adaptive Fault Tolerance running on a Cloud Computing Environment). The cloud computing environment distributes IT (Information Technology) resources and allocates according to user's request, so there should be a study on technology that manages these resources effectively. An example of ubiquitous applications based on a cloud computing environment is a multimedia education system. Since ubiquitous applications based on a cloud computing environment need situation-aware middleware services and computing environment (e.g., resources) keeps changing as the applications change, it is challenging to detect errors and recover them in order to provide seamless services and avoid a single point of failure for a cloud computing environment.

Keywords *AFT_CCE, Fault Tolerance, Cloud Computing Environment*

1. Introduction

In cloud computing, a user lends IT resources (software, storage, server, network) as needed, uses them, gets a support of real-time scalability according to service load, and pays as he/she goes. Especially the cloud computing environment distributes IT resources and allocates according to user's request, so there should be a study on technology that manages these resources effectively [1]. Context awareness (or context sensitivity) is an application software system's ability to sense and analyze context from various sources; it lets application software take different actions adaptively in different contexts [2]. In a ubiquitous computing environment, computing anytime, anywhere, any devices, the concept of situation-aware middleware has played very important roles in matching user needs with available computing resources in transparent manner in dynamic environments [3, 4]. The development of communication and data networks enables collaborative systems to support diverse activities such as crisis management, cross-continental conferencing, and distributed learning. Moreover, multimedia is deployed in collaboration to enhance usability and productivity. For example, in addition to the text and graphics information in text-chat and whiteboard, stream-based media such as audio and video are widely used [5].

This research is about a platform developed for the research of AFT_CCE (an Adaptive Fault Tolerance running on a Cloud Computing Environment) based on situation-awareness. Section 2 describes cloud computing. Section 3 denotes the AFT_CCE architecture and algorithm. Section 4 describes simulation results and conclusion.

2. Related Works

As shown in Figure 1, cloud computing is a general term for anything that involves delivering hosted services over the Internet.

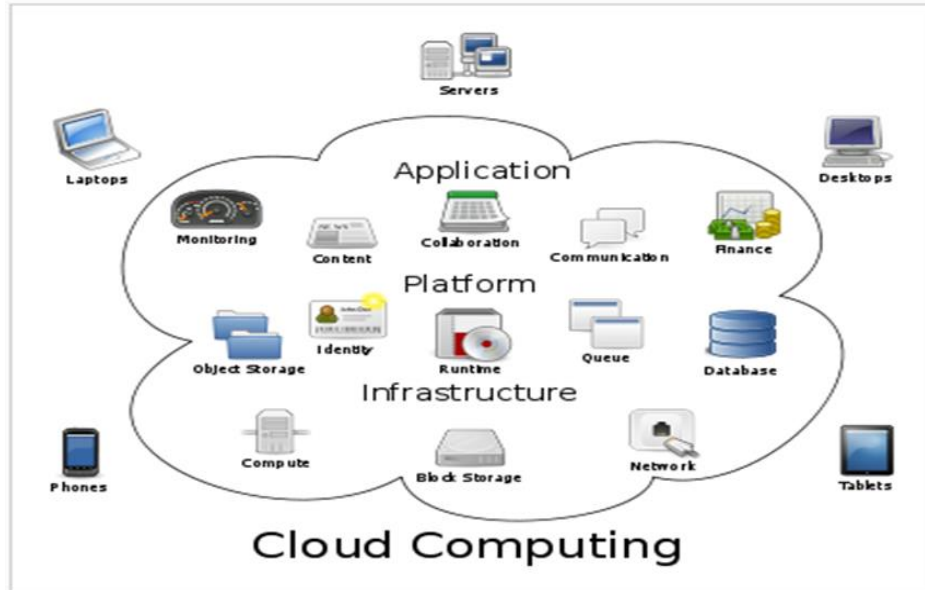


Figure 1. Cloud Computing Logical Diagrams [6]

As shown in Figure 2, these services are broadly divided into three categories: Infrastructure-as-a-Service (IaaS), Platform-as-a-Service (PaaS), and Software-as-a-Service (SaaS).

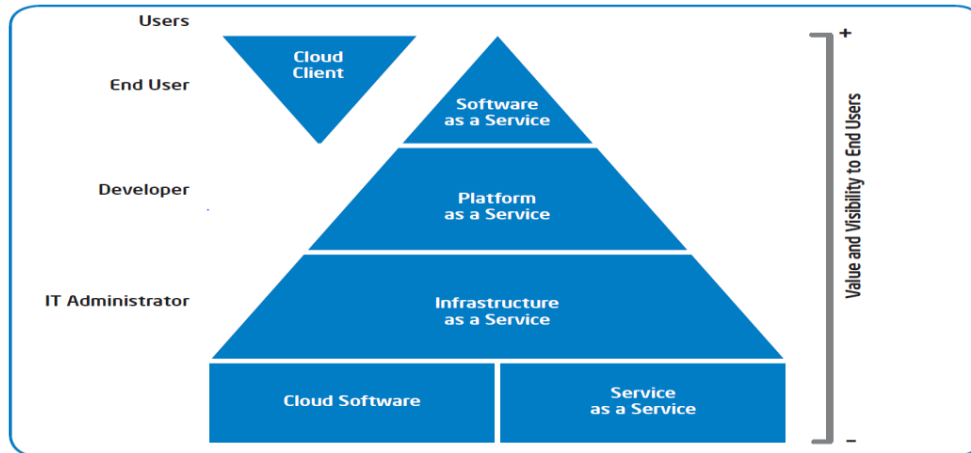


Figure 2. Cloud Computing Categories [7]

A conceptual architecture of situation-aware middleware based on Reconfigurable Context-Sensitive Middleware (RCSM) is proposed in [8]. However, RCSM did not include services for cloud computing, other services, and error control support in the architecture. In this paper, we propose a new error control mechanism running on situation-aware middleware for cloud computing.

3. An Adaptive Fault Detection and Recovery System running on a Cloud Computing Environment: AFT_CCE

This paper describes AFT_CCE. It is a fault-tolerant system for multimedia collaboration agent such as DooRae is an example of multimedia collaboration agent running on AFT_CCE. It has been implemented for construction and experiment of effective DooRae environment.

3.1. Hardware as a Service: RCSM

Ubiquitous applications require use of various contexts to adaptively communicate with each other across multiple network environments, such as mobile ad hoc networks, Internet, and mobile phone networks. However, existing context-aware techniques often become inadequate in these applications where combinations of multiple contexts and users' actions need to be analyzed over a period of time. Situation-awareness in application software is considered as a desirable property to overcome this limitation. In addition to being context-sensitive, situation-aware applications can respond to both current and historical relationships of specific contexts and device-actions. All of RCSM's components are layered inside a device, as shown in Figure 3. The Object Request Broker of RCSM (R-ORB) assumes the availability of reliable transport protocols; one R-ORB per device is sufficient. The number of Adaptive object Containers (ADC)s depends on the number of context-sensitive objects in the device. ADCs periodically collect the necessary "raw context data" through the R-ORB, which in turn collects the data from sensors and the operating system. Initially, each ADC registers with the R-ORB to express its needs for contexts and to publish the corresponding context-sensitive interface. RCSM is called reconfigurable because it allows addition or deletion of individual ADCs during runtime (to manage new or existing context-sensitive application objects) without affecting other runtime operations inside RCSM. However, it did not include fault-tolerance support in the architecture. In this paper, we propose a new fault-tolerance capability, called "AFT_CCE (an Adaptive Fault Tolerance running on a Cloud Computing Environment) in situation-aware middleware.

3.2 Other Services of RCSM: Multimedia Collaboration Agent

As shown in Figure 3, multimedia collaboration agent includes many agents. They are AMA(Application Management Agent), IA(Intelligent Agent), SMA(Session Management Agent), ACA(Access Control Agent) and MCA(Media Control Agent), AFT_CCE(an Adaptive Fault Tolerance running on a Cloud Computing Environment). AMA consists of various subclass modules. It includes creation/deletion of shared video window and creation/deletion of shared window For providing heterogeneous platforms with interoperability, it is necessary to share media data and to furnish awareness to the remote users involved in collaborative work.

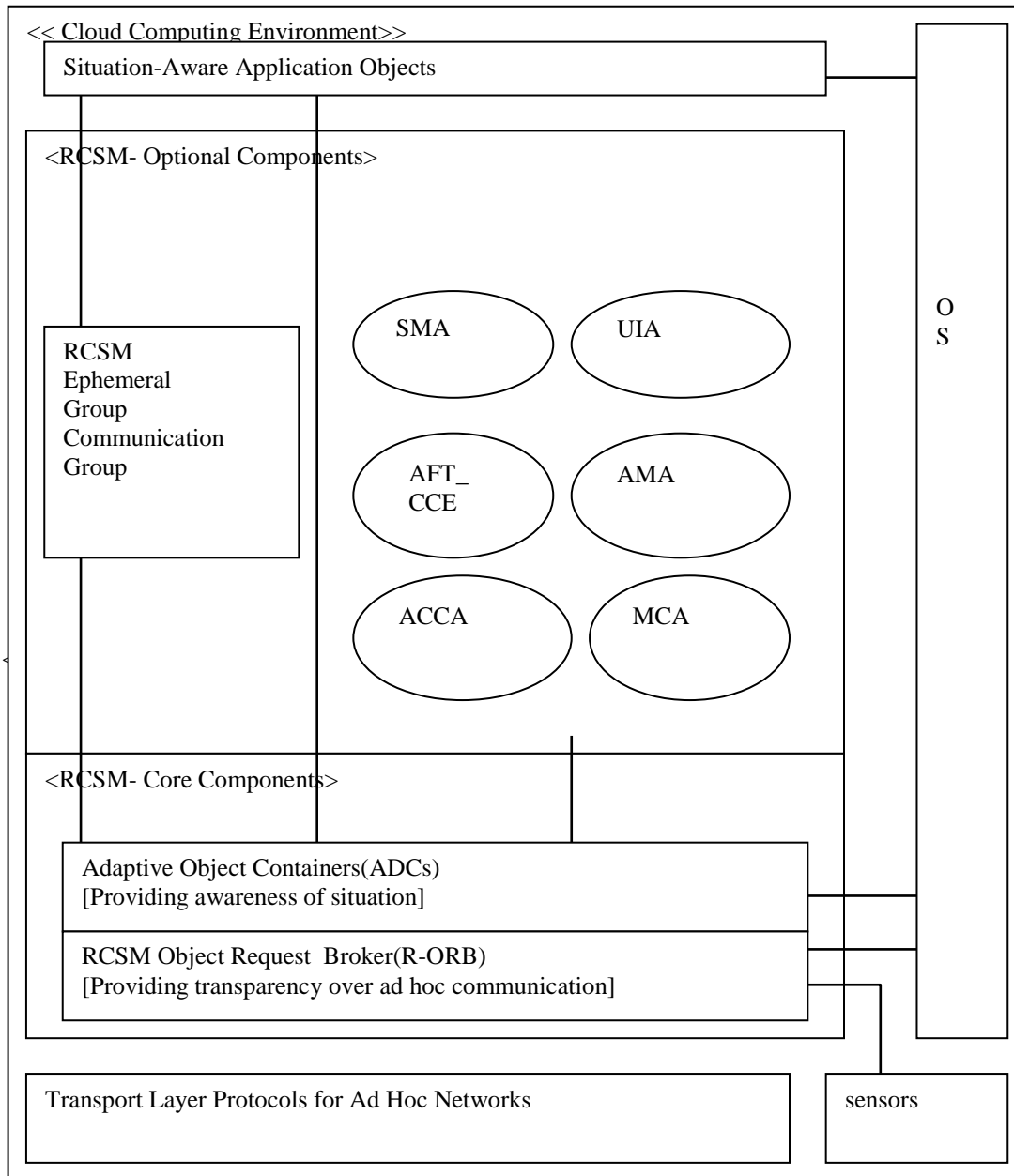


Figure 3. RCSM's integrated components for a Cloud Computing Environment

To solve the problem, we set the Intelligent Agent that modifies the transmitting packets by using TCP/ IP or UDP. Event messages including information about shared objects are bypassed among the homogeneous. SMA controls the access to the whole session. This agent can be used in meeting, distance learning, playing games and development of any software. Session control also facilitates access and limits it to the whole session. ACA controls the person who can talk, and the one who can change the information. The mechanism of floor control consists of brainstorming, priority, mediated, token-passing and time-out. MCA

supports convenient application using multimedia collaboration environment. Supplied services are the creation and deletion of the service object for media use and media share between the remote users. This agent limits the service by hardware constraint [9-12].

3.3 Adaptive Fault Tolerance Agent running on RCSM for a Cloud Computing

As shown in Figure 4, you can see the message flows in relationship between AFT_CCE and the application software. It consists of a user, AFT_CCE and the watched application software.

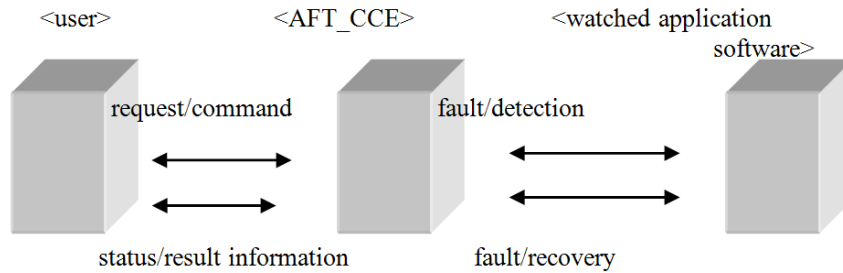


Figure 4. The Relationship between AFT_CCE and Application Software

AFT_CCE consist of FDRA (Fault Detection and Recovery Agent), UIA (User Interface Agent) and SMA (Session Management Agent). As shown in Figure 5, you can see the message flows in organization of AFT_CCE. UIA is a agent which plays a role as an interface to interact between the user and FDRA. UIA is a module in AFT_CCE. UIA has functions which receive user's requirement and provide the results for the user. SMA is an agent which plays a role in connection of UIA and FDRA and as management for the whole information. SMA consists of GSM (Global Session Manager), Daemon, LSM (Local Session Manager) and PSM(Participant Session Manager).

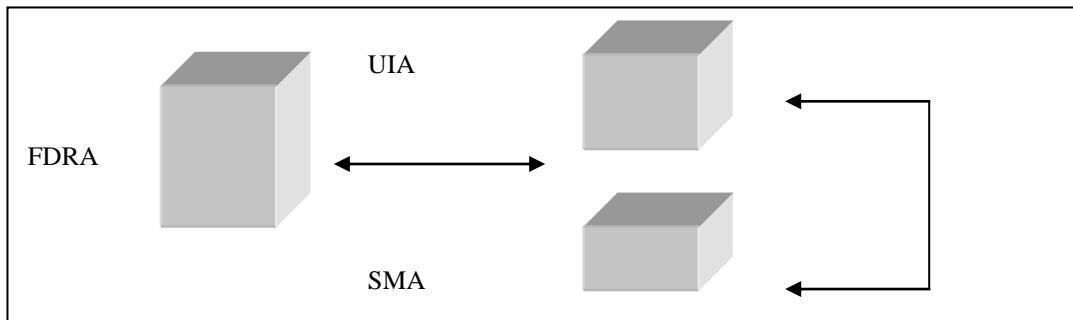


Figure 5. The Organization of AFT_CCE running RCSM for a Cloud Computing Environment

At times during the process of multimedia collaboration agent's session running on RCSM for a cloud computing environment, there may occur abnormal session endings, such as on media service instance. In this case, it is necessary to protect users from error by reactivating the media service. We are first in need of a method to detect error for the session's recovery. One of the methods to detect error for session's recovery inspects process database periodically running on RCSM for a cloud computing environment. But this method has a weak point of inspecting all process without regard to multimedia collaboration agent's

session. Therefore, we propose AFT_CCE. This method detects error by polling periodically the process with relation to multimedia collaboration agent's session. As shown in Figure 6, AFT_CCE can create the sequences below in case of decision to be restored.

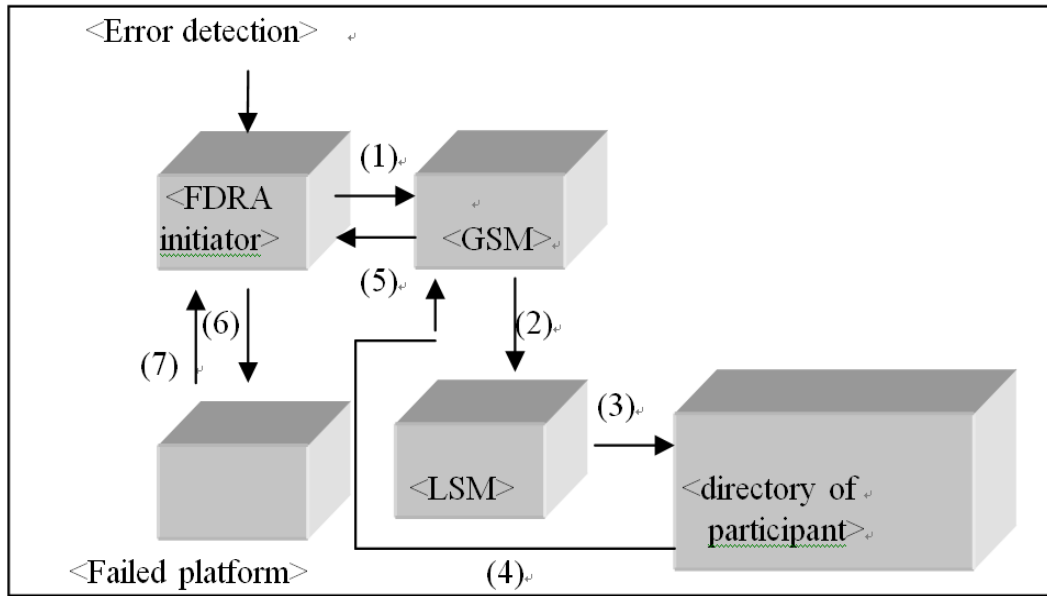


Figure 6. Process of information exchange between FDRA and SMA running RCSM for a Cloud Computing Environment

4. Simulation Results and Conclusion

AFT_CCE is a system which is suitable for detecting and recovering software error running on situation-aware computing environment for a cloud computing environment by using software techniques. The purpose of AFT_CCE is to recover application software of multimedia collaboration agent running on RCSM for a cloud computing environment automatically and repeatedly. All application software running on RCSM for a cloud computing environment returns to a healthy state or at least an acceptable state.

As seen by Table 1, RCSM did not include services for cloud computing, other services, and error control support in the architecture. In this paper, we proposed a new error control mechanism running on RCSM for a cloud computing environment.

Multimedia collaboration agent running on RCSM for a cloud computing environment integrates multimedia environment with its system and provides real time prompt interaction among users during data flow. The purpose of this research is to maintain and recover for multimedia collaboration agent's session running on the situation-aware computing environment. This fault-tolerant system was designed and implemented on multimedia collaboration agent running on the situation-aware computing environment. That is, the purpose of this research is for the establishment of a real-time multimedia collaborative distributed education environment through multimedia collaboration agent environment running on the situation-aware computing environment. It is designed and implemented as a collaborative multimedia application crafting environment in the Ethernet or ATM.

Table 1. Comparison for Software Architecture running on situation-aware for a cloud computing environment

	RCSM	Cloud Computing	Proposed
Situation-awareness	Yes	No	Yes
Cloud Services	No	Yes	Yes
Fault Tolerance	No	No	Yes

5. Conclusions

This paper proposes an reliable collaboration system in situation-aware middleware framework such as home network environment and presents its simulation model of agent-based. It provides several error detection and recovery functions and features capable of developing multimedia distant system among users during data flow. It is a system that is suitable for detecting and recovering software error based on multimedia collaboration environment by using software techniques. There are several constraints which must be satisfied to provide guarantees during multimedia transmission. They are time, space, device, frequency, and reliability constraints. We proposed a method for increasing reliability through an adaptive reliable QoS for resource errors model for ubiquitous computing environments such as home network system. The model for smart home network system aims at guaranteeing it through application QoS. QoS for smart home network system guarantees must be met in the application, system and network to get the acceptance of the users of multimedia communication system.

Our future works are QoS-aware middleware of ubiquitous and heterogeneous environments for smart home network system.

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Authors



Soongohn Kim, he received Ph.D. degrees from Chonbuk National University, Seoul Korea, in Computer Engineering in 1999. He has been working as a Professor in Joongbu University from March 1995. His research interests include Ubiquitous Computing, Distributed Computing, Database Integrity, Cryptographic Protocol, A methodology of Software Development, Software Evaluation, Networks and so on.



Eungnam Ko, he received Ph.D. degrees from Sungkyunkwan University, Seoul, Korea, in Computer Engineering in 2000. He has been working as a Professor in Baekseok University from March 2001. His research interests include Web Services, Multimedia, Ubiquitous Computing, Distributed Computing, Fault Tolerance, Distance Education and so on.