SCCM: Service-oriented Community Coordinated Multimedia Architecture

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Abstract

Community coordinated multimedia (CCM) envisions the paradigm of consuming multiple media via diversity display devices, converged networks, and heterogeneous platforms within a virtual, open and collaborative community. This paper applies service orientation approach and Web services technology to establish a Service-oriented CCM architecture (SCCM) for tackling requirements of scalability, discoverability, composibility, layered abstraction, QoS and agility in distributed collaborative multimedia management. A generic CCM scenario is examined. CCM service model is designed with service-orientation principles. A prototype of CCM is implemented with supporting multimedia publish, streaming, and viewing within SCCM.

Keywords: Service-orientation, SOA, community coordinated multimedia, Web services

1. Introduction

Personal experiences emerge from the active participation in events or activities and lead to the accumulation of knowledge, skill and enjoyment. This is made possible by ever-growing amount of networked multimedia content and services together with growing penetration of broadband Internet connections. Collaborative use of multimedia and services empowers users to experience the real world and share it with other users. In this paper, we first generalize the above described emerging technical phenomena with a term 'Community Coordinated Multimedia' (briefly, CCM). The shift towards CCM-driven user experience is manifested by several web services that have become popular in recent years, such as Wikipedia [1], Flickr [2], YouTube [3], Joost [4] and Google Maps [5].

Service-oriented term has been used in different contexts and for different purposes. One common has been that it represents a distinct approach for separating concerns. That is that within an IT architecture the resources are cleanly partitioned and consistently represented. Each of these pieces addresses a concern or a specific part of the problem. This model applies equally to a task, a solution, an enterprise, a community, and beyond [6].

We regard service-orientation as a distinct view of perceiving the software system world. This view is beneficial not only to break down a large problem into a series of individual concerns, namely services, but also support registry, discoverability, composibility of services, further evolution, extensibility and agility of a software system management. Existing Web services technologies, i.e., WSDL [7], SOAP [8], and UDDI [9] are widely used to actualize service-orientation and contributed to a number of the above common Service Oriented Architecture (SOA) characteristics. WSDL-defined service documents accommodate the abstract and concrete descriptions of services with the supplemental documents of XSD (XML Schema) and policy, which are basic requirements for establishing a consistently loosely coupled form of communication between services. UDDI provides mechanisms and central directories for advertising and discovering service descriptions. SOAP provides a standardized and extensible messaging framework accommodating intelligence-heavy and self-sufficient message structures, e.g., message routing, reliability rules and context information, etc. Evolving WS-* specifications are designed for addressing the broaden features of service-orientation, e.g., WS-Coordination [10], WS-Security [11].

Service-orientation system design and technology exhibits strong potentials in leveraging and reinforcing CCM system development in coordination, composiblity, discoverability, extensibility and agility of multimedia consumption via diversity executing environments. This paper presents the initial result of service-oriented analyzing and modeling for the EUREKA ITEA 2 project CAM4Home[1] that focuses on creating a metadata-enabled content delivery framework. The remainder of the paper is organized as follows. Section 2 defines basic concepts relevant with CCM and SOA. Section 3 presents a generic CCM scenario and analyzes the underlying multimedia processing flow. Section 4 models and specifies CCM services with a brief address of service-orientation approach. Section 5 presents the implementation of a CCM prototype. Section 6 concludes the paper with discussing future work.

2. Definitions

[1] http://www.cam4home-itea.org/

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Multimedia represents a synchronized presentation of bundled media types, such as text, graphic, image, audio, video, and animation.

CCM (Community Coordinated Multimedia) system maintains a virtual community for the consumption of CCM multimedia elements, i.e. end user generated content and content from multimedia services (e.g., Video on Demand service), namely End user Subscribed Service (ESS). The consumption involves a series of interrelated multimedia processes such as content creation, aggregation, annotation, ESS publish, etc.

End user is a person who has a personal profile managed in the CCM System. They are the actors who interact with CCM for generation and consumption of CCM multimedia elements.

Service-oriented CCM (SCCM) refers to a architectural view of modeling CCM system which is analyzed and designed in compliant with principles of service orientation modeling (e.g. service discoverability, service autonomy, service composability) and implemented by utilizing Web services technology.

3. CCM scenario and process description

3.1. Collaborative multimedia creation scenario

A generic scenario below addresses how CCM extends user multimedia experiences by consuming CCM elements within a virtual community. The scenario starts with aggregating multimedia on the digital photo showing ice hockey ticket. A family father, Bob, watched a live professional ice hockey tournament 'Nordic Trophy 2007' game between Kärpat and Linköping HC teams last week's Saturday in Oulu, Finland. On this week's Sunday he wants to share the experience with his daughter Nemo. Since he didn't take a video record of the events, he tries to find content from the fan community. Luckily, he kept his ticket.

(1) Bob takes a photo of his ticket, and uploads the image named 'Nordic Trophy 2007' to the CCM system with a following comment: 'does anyone have a video of goals made in last week's game of Nordic Trophy 2007?'

(2) John is also an ice hockey fan. He receives a message tagged as 'news on ice hockey' from the CCM system a few minutes later. He views the Bob's image 'Nordic Trophy 2007' and his request. He also attended the game and fortunately made a video record of the goals. But he missed the last game that was played in Linköping, Sweden yesterday.

(3) John makes available his recorded video and links it to the image 'Nordic Trophy 2007' with a tag 'Nordic Trophy 2007 goal videos from Saturday last week' and a comment 'looking for Nordic Trophy 2007 yesterday's game goal videos '.

(4) Alice, living in Linköping, another ice hockey fan, watched the yesterday's Nordic Trophy 2007 game and made a video record of the goals. She receives a message from the CCM system 'news on ice hockey'. She views the tagged and commented content by John, and adds the video 'Nordic Trophy 2007 yesterday goals' to the original content bundle 'Nordic Trophy 2007' and a comment 'who was the best player?'.

(5) George, a professional TV sports reporter, spots the Alice's question in the CCM system. He has made an interview with the best player, Toni, after the game. The interview content is hosted in his company's video-on-demand server. He registers the service 'Nordic Trophy 2007 interviews' in the CCM system.

(6) George adds a service link to the aggregated content 'Nordic Trophy 2007' with a tag 'interview with the best player Toni'.

(7) At home, Bob receives one message 'news on ice hockey'. He logs in to the CCM system and watches the entire 'Nordic Trophy 2007' content bundle with Nemo.

(8) In the middle of the video playback, Bob activates 'Nordic Trophy 2007 interviews' service, and enjoys the interview created by George's company.

3.2. Process-centric CCM description

Figure 1 illustrates the above CCM scenario in a process-centric way, which will be the basic document for the design of CCM services. A brief description of the CCM processes is as follows: (1) a user Bob records a video clip consisting of a real world event, say a named person or object. (2) the system analyses the contents and creates a list of conceptual descriptions of the content: attributes of the recorded scene (e.g. outdoor, indoor, nature, sky, man-made structure); detected entities (e.g. faces); audible concepts (e.g. speech, background noise, music, shouting, natural sounds). (3) Bob verifies the detected concepts, and optionally inserts descriptive value to the metadata bundle (names for the detected faces and name for the location). (4) Bob publishes the produced media to the community network, where aggregated metadata is received by the peers of the network. (5) search and filter functionalities promote the multimedia content to the peers. (6) an interested peer (Alice) downloads the media to a local terminal via community network. (7) Alice creates an aggregated bundle containing also the media produced by Bob and a snippet of related commercially produced media. (8) Alice delivers her aggregated multimedia production to Charlie. (9) Charlie consumes the multimedia and follows the bundled reference to a forum that contains discussions related to the multimedia content.

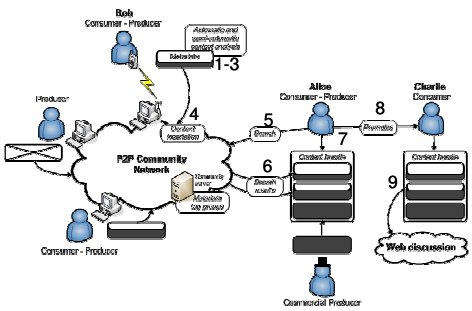

Figure 1. CCM multimedia processing flow

4. Service-oriented CCM design

4.1. CCM service layer

A three primary service layers model was addressed in [6]. To provide a CCM automation solution, we abstract two CCM service layers, i.e., CCM business service and application service layers as Figure 2. This layered structure alleviates us to build services that take CCM business, application, and agility into considerations.

Within this model, the CCM business service represents the most fundamental CCM building block, encapsulating a distinct set of multimedia business logic within a well-defined functional boundary and bringing the representation of corporate business models into the web services arena. Section 4.3 presents the detail about CCM business services. CCM business services are considered fully autonomous and frequently expected to participate in service compositions. It is more than likely that CCM business services will act as controllers to compose available CCM application services to execute their business logic.

The CCM application service layer establishes the ground level foundation that exists to express technology specific CCM multimedia processing functionality. CCM application services are responsible for representing technology and application logic. Their purpose is to provide reusable functions related to processing CCM multimedia elements within new or legacy application environments. CCM application services have the following common features: 1) expose multimedia functionality within a specific processing context; 2) draw upon available resources within a given platform; 3) they are generic and reusable to achieve point-to-point integration with other application services;

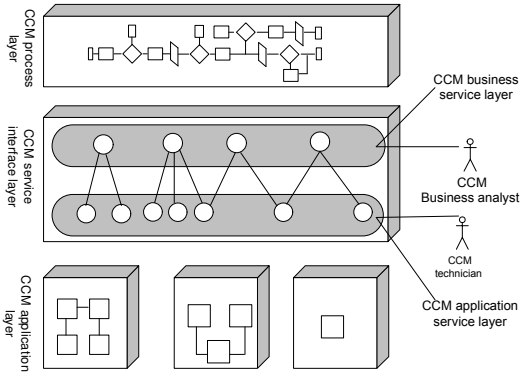

Figure 2. CCM service modeling layers

4.2. CCM service design

Continually, modeling CCM services is required to define a set of service candidates and their logical contexts. A high level service-oriented modeling process was presented in [6]. Its customized procedure (i.e. decompose CCM process, identify CCM business services, and identify CCM application services) is applied to identify CCM services with the multimedia processing description given in Section 3.2. Table 1 presents the refined CCM services by using task-centric service modeling method. Task-centric service modeling derives services from the sources of business process management and analysis of process workflow. Typical sources include use-case models and process description. A good example of this method is as BPML [12] process modeling. The specification of CCM business and application services is omitted in this paper due to the limited space.

Table 1. Services identified in service-oriented CCM

Application service layer ESS-awareness	Business service layer	Application service layer Content-awareness
ESS publish	Discover service	Content creation
ESS guide	Registry service	Content annotate
ESS notification	User profiling	Content aggregation
	Eventing	Content retrieval
	Messaging	
ESS authorization	Searching	Content collection
	Streaming	Content sharing
ESS delivery	Downloading	
	Adaptation	Content viewing
ESS viewing	Annotation	Content moderating

5. Prototype implementation

The initial SCCM prototype aims to present the end user an SOA environment facilitating the creation and consumption of ESS elements regardless of deploying environment and accessing devices. Specifically, the technical solution includes Java programming

language, J2EE SOA development environment. The main implemented services are user profiling service, ESS delivery service, ESS viewing service. As a CCM business service the user profiling service encapsulates the logic of user information management to support the CCM applications such as user login, preferenced CCM multimedia elements delivery, etc. ESS delivery service fulfills the task of streaming CCM multimedia elements by utilizing J2EE HTTP-Streaming API. Java Media Framework [13] is mainly used for developing ESS viewing service for the support of navigating, playing, rewarding and forwarding multimedia elements. SOAP/HTML is used for accommodating communication messages between CCM services. The implementation provides a preliminary service-oriented CCM prototype for addressing multimedia consumption in a collaborative, discoverable and registered way.

6. Discussion and conclusion

With the incorporation of service-orientation approach, CCM architecture is partitioned into service units; relatively independent of each other, ability to communicate with each other. CCM services are designed into CCM business service layer and application service layer, leveraging and enforcing the following requirements issued by the emerging CCM paradigm:

- SCCM support composibility, the concept of service composibility is a deep-rooted characteristic of service orientation approach. CCM services exist as independent units of logic, which enables breaking down CCM multimedia processing into a series of services, each responsible for executing a portion of the CCM process logic. CCM service composition is frequently governed by WS-* composition extensions, such as WS-BPEL [14] and WS-CDL [15], which introduce the related concepts of orchestration and choreography respectively.
- SCCM promotes discovery. SCCM is designed by utilizing the principle of service discovery. SCCM supports and encourages the advertisement and discovery of CCM services throughout the CCM community and beyond. Our implementation actually uses a registration service as a part to fulfill the concept.
- SCCM leverages legacy systems. SCCM leverages the legacy investment by supporting vendor diversity, e.g., our previously developed standalone content annotation. In this case, service-orientation approach enables us to encapsulate the legacy content annotation logic, standardize a content annotation service interface, and expose interoperability opportunities with other services.
- SCCM promotes agility. Agility is a quality inherent in just about any aspect of the system. One of primary benefits of SCCM is to protect CCM system from the impact of the CCM business extension and IT technology evolution. SCCM provides a standardized technical environment comprised of loosely coupled, composable, and interoperable CCM services establishing a more adaptive automation.

This paper utilizes service-orientation approach to model the CCM paradigm. It starts with the mapping between the domain requirements of CCM and the support of service-orientation approach. A generic scenario is examined for identifying CCM features and multimedia processing flow. Further, the service-oriented CCM model is designed mainly focusing on identifying and specifying CCM business services and application services. A preliminary prototype is implemented with the CCM service development of ESS publish, user profiling and ESS viewing. The future tasks in realizing SCCM include: 1) refine and enhance SCCM architecture design; 2) test CCM services. CCM services are required to undergo rigorous testing prior to deployment; 3) develop content-based annotation applications within SCCM by encapsulating pre-developed content annotation logic into Web services.

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