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Decentralized Electronic Process Execution Framework in Global Village Services Reference Model

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Abstract- Web service paradigm and related technologies have provided desired means for the realization of electronic processes that are based on a centralized management approach. Large scale electronic processes require particular considerations on scalability, heterogeneity, availability issues that in turn, require particular consideration on distribution. We investigate some characteristics of centralized and distributed electronic process execution approaches. This paper is also a study to extension of our previously published book, which has introduced Global village services reference model (GVSRM) as a reference model, which could be used to develop and unify E-Commerce, E-Business, and E-Government services as the software artifacts [15] . Our main aim is to present a framework which enables dynamic electronic processes distribution based on runtime circumstances in GVSRM. The proposed technique provides a generalized approach to the distribution of processes.

Keywords- *process execution, distribution, dynamic workflow, GVSRM*

I. INTRODUCTION

In today's large scale business and government environments, cross-organizational collaborations composing supplementary services and thus realizing new, value-added products acquire increasing importance. As a technical presentation of such electronic processes, executable workflows allow for flexible, dynamic collaboration among several users [16]. Users from all over the world are searching for ways to support their electronic processes using web services technology. Favorably, service-oriented business, commerce and government integration takes the on demand composition of new electronic processes using existing web services and minimizing the development of new applications. Services are orchestrated on the basis of an electronic process specification, which in turn may be changed "on the fly". In this way a service-oriented architecture promises to create the necessary flexibility in electronic processes so changes in law can be supported quickly, functionality encapsulated in components can be reused in various electronic processes [8]. Despite the electronic process model may need to be designed as a whole to have an end-to-end definition, the true execution of the process may need to be distributed across all participating partners so this gives permission to distribution of the process control, visibility and responsibility of the process execution [12]. In general, this research includes the following contributions:

- Discussion about the potential advantages and drawbacks of the centralized and distributed electronic process execution.
- An overview of an end-to-end electronic process structure in Global village services reference model (GVSRM).
- Propose a decentralized electronic process execution framework in GVSRM

II. ELECTRONIC PROCESS EXECUTION

An electronic process is a collection of related tasks that need to be executed in an order determined by a set of conditions. Its most important goal is to produce a specific service or product for a particular customer or customers. By setting up the process model and enacting it in the workflow server, a workflow system can help to simple the electronic process, deliver tasks and documents between participants, and monitor the overall performance of the electronic process.

In describing a workflow model, the literature has been using the basic workflow terminology .The followings are the basic definitions of the primitive entity types in electronic process execution framework:

- A workflow is the computerized facilitation or automation of a business process, in whole or part, during which documents, information, or tasks are passed from one participant to another for action, according to a set of procedural rules [11].
- A task is a logical unit of work that is carried out as a single whole by one resource and needs to be accomplished within a defined period of time [11].
- An activity is a conceptual thing of the basic unit of task, and the activities in a workflow procedure have precedence relationships, each other, in terms of their execution sequences [10].

Global village applications are typically modeled as workflows, consisting of tasks, data elements, control sequences and data dependencies.

A. Centralized electronic process execution

By setting up the process model and enacting it in the workflow server, a workflow system can help to simple the electronic process, deliver tasks and documents among users. The Workflow execution can be realized by centralized approach where workflow is executed by only one workflow engine placed on single server, so the workflow engine must communicate with each task performer, deliver essential information and retrieve each task result. Model has been framed to show the workflow execution is illustrated in figure1: In the figure sequence of three activities are named as activity1, activity2 and activity3 for workflow execution. Here single workflow engine handles all the services by sending and receiving the service invocation before and after processing. Service 'S1' after completing the process sends back the result to workflow engine, only then task for the service 'S2' is sent. So each and every service has to wait for the other services to complete their process and get result.

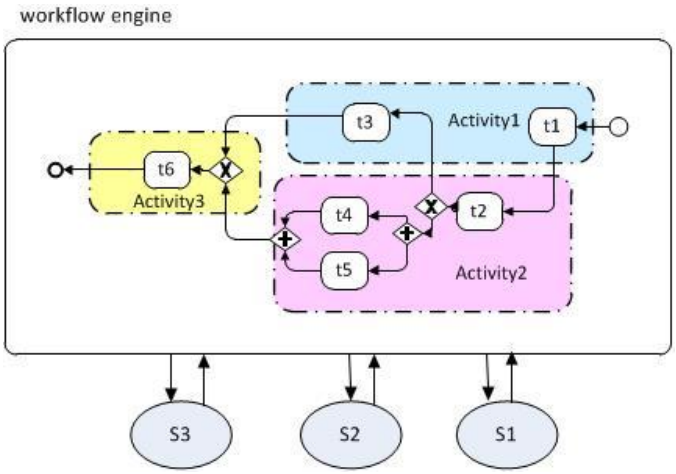

Figure 1. Centralized electronic process execution

Some of the advantages and disadvantages in centralized systems can be described as follows:

Advantages:

- Monitoring and management of process executions become relatively straightforward.
- In lightly loaded engines, centralized approach has more suitable throughput.

Disadvantages:

- This creates a performance bottleneck and single point of failure.
- A central coordinator also decreases Scalability.
- Unnecessary network traffic and performance degradation it creates.
- This can easily reduce overall performance while the number of services to be orchestrated gets larger [2].
- It is usual difficult to select a useful location of the central engine for cross-organizational electronic processes.

B. Distributed electronic process execution

In distributed workflow execution approach, the whole electronic process is to be executed at multiple sites instead of a single one, so the workflow must be partitioned into small fragments and transferred to their related sites. In fact to solve the difficulties that centralized workflow approach cannot overcome, many distributed workflow approaches have been presented from different aspects. A way to achieve this distribution is electronic process model fragmentation. A process fragment is an arbitrary subset of the process elements comprised within a process model and fragmentation is the act of creating process fragments out of one process model by applying a fragmentation technique. Distributed approach model has been illustrated in figure2. Here activity1, activity2, activity3 are handled by three different work engines namely workflow engine1, workflow engine2 and workflow engine3. Each work engine is dedicated to its activity. Where work engine 'workflow engine1' is dedicated to activity 'activity1', work engine 'workflow engine2' is dedicated to activity 'activity2', and workflow engine3 is dedicated to 'activity3'.

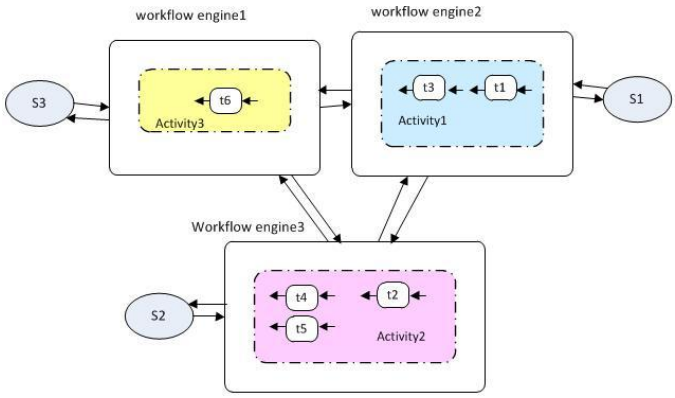

Figure 2. Distributed electronic process execution

Some of the advantages and disadvantages in distributed systems can be described as follows:

Advantages:

- Enhanced scalability by outsourcing the business functionalities.
- Increased flexibility by assigning execution sites on-the-fly.
- A significant decrease in network traffic.
- Improved concurrency and availability.
- Asynchronous send and receive of messages.

Disadvantages:

- Service orchestration and process management, including fault handling and recovery, and strategies to mitigate business constraint violation, become more challenging due to the absence of centralized states [2].
- Even small changes in the process flow result in big changes to all the different process engines.

III. END-TO-END ELECTRONIC PROCESS STRUCTURE IN GVSRM [15]

Global village services reference model (GVSRM) is a reference model, which could be used to develop and unify E-Commerce, E-Business, and E-Government services as the software artifacts. GVSRM could be referenced as the baseline of any kind of software engineering efforts pertaining to the E-service, Globalization, and the Grid Computing concepts. Furthermore, some Grid based entities, actors, actions, and their associations, which defined and elaborated in detail in GVSRM, would realize E-Government, E-business, and E-Commerce systems. A transformed enterprise over the Global Village Grid has some end-to-end electronic processes in its enterprise model. An End-to-End Electronic Process would be compounded from some different Global village services, which each of them is instantiated from a Global Village Layer of the mentioned 5-layers;e.g.,as figure3,'End-to-End Electronic Process 2' encompassed from 3 simple global village services,3 composite or hierarchical global village service,3 dynamic or on demand global village services, so on. In the other hand, a global village electronic process is a combination of global village services, which can satisfy a global village service actor in its interests.

IV. DISTRIBUTED ELECTRONIC PROCESS EXECUTION FRAMEWORK IN GVSRM

Service orchestrations are a normal approach to compose singular services to either higher-level services or complex composite applications. The electronic process is deployed on an individual workflow management system which interprets the process definition and interacts with the orchestrated web services on behalf of the user. In this paper, we present a framework which enables dynamic electronic processes distribution based on runtime circumstances. Usually exist approaches use physical fragmentation of electronic processes and use dynamic assignment of resulting static process parts to different participants. In order to use a more dynamic fragmentation, this paper presents dynamic management component based on runtime circumstances. Figure4 presents a distributed electronic process execution framework in GVSRM. A process model designed in some executable language. Before an executable business process model is created, the goals it should achieve and a high-level process model are designed. These features are delivered through a web portal or through an application that is installed at the user's end. Workflow parsing is done using a workflow language parser. The workflow scheduler uses user-selected scheduling policies and plans to the workflows at different steps in their execution. In this part, a dynamic workflow fragmentation component translates the processes to workflow fragments and wires them so as they can communicate through a middleware. The fragments are then stored in a fragment repository. At deployment time the fragment dispatcher takes fragments from the fragment repository, instantiated and sent to the mobile agents. As the size of workflow is increased by including many fragments, multiple mobile agents should be used where each agent is responsible for a fragment of the workflow process and fulfills the workflow goal by cooperating with its partners [7].

The proposed framework is formally defined through 5-tuple DEPEF = (EP,F,WE,£,δ) over electronic process set EP, a fragment set F, a workflow engine set WE, a fragment technique set £, and a set δ includes encapsulate functions, which assign a fragment to a mobile agent or web service ,etc. Providing an exhaustive list of fragmentation techniques for fragmenting electronic process is beyond the reach of this work and better suited for an extensive survey paper. However, some examples may help the reader. The most popular techniques for fragmenting electronic process are task driven [12], role driven [4], actor driven, model driven [10], control-path driven [10], functional fragmentation, fragmentation based on QoS and

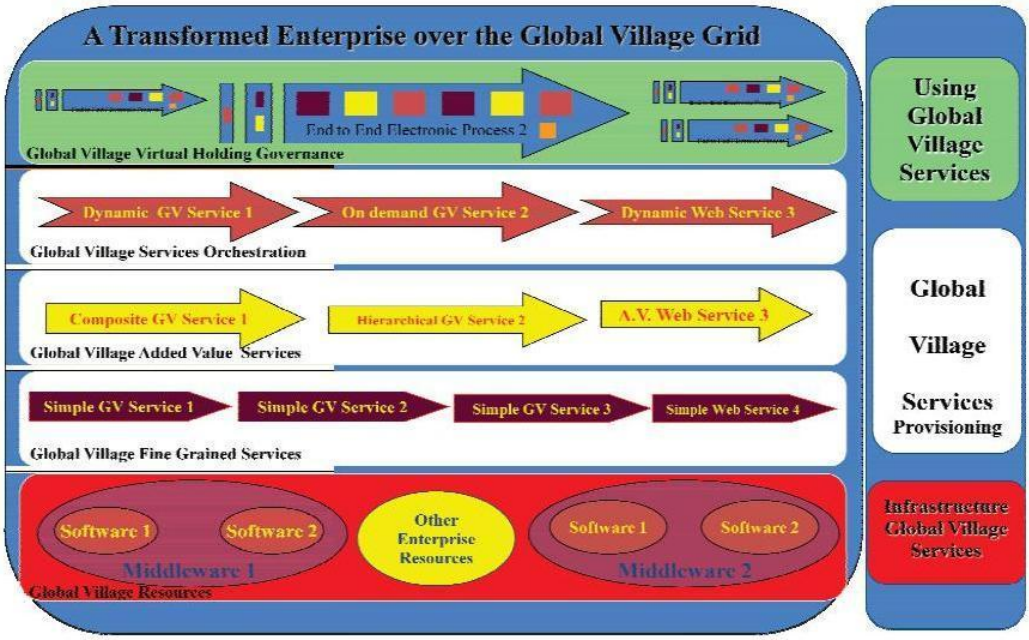

Figure 3. End-to-end electronic process structure in GVSRM

context or based on process variants [5], etc. GVSRM is to use one of fragmentation criteria or combination of both of them for electronic process based on runtime circumstances. For example, imagine that we use the role-based workflow fragmentation technique to each of the control-path driven workflow fragment approaches. Then, as the result of the compound approach, a set of the role-based re-fragment models can be generated from the applied control-path fragment model, and the re-fragmented models are distributed onto the nodes of a collaborative workflow computing environment. As a consequence of this atmosphere, we need to be concerned about the massively parallel and very large scale enterprise and workflow management systems of GVSRM in future.

V. CONCLUSION

In this paper, we examined the potential advantages and drawbacks of the centralized and distributed electronic process execution. In lightly loaded engines, centralized approach has better throughput; however, when the load is increased then distributed approach gets better throughput than centralized approaches. while the centralized approach is still good due to the ease of electronic process management and monitoring; however, there are situations where distributed approaches are better solutions, for instance, whenever there is no proper place for the central engine or when the engine gets congested [2].Then we focuses on distributed electronic process execution framework in GVSRM that can be applied into the very large scale workflow models and their enactment systems and systems based on the emerging computing environment, Cloud computing environments and paradigm and this increase the scalability and availability of the global process flow. Further research involves the implementation of proposed framework and we intend to test on availability (stress testing) and scalability of the distributed electronic process flow.

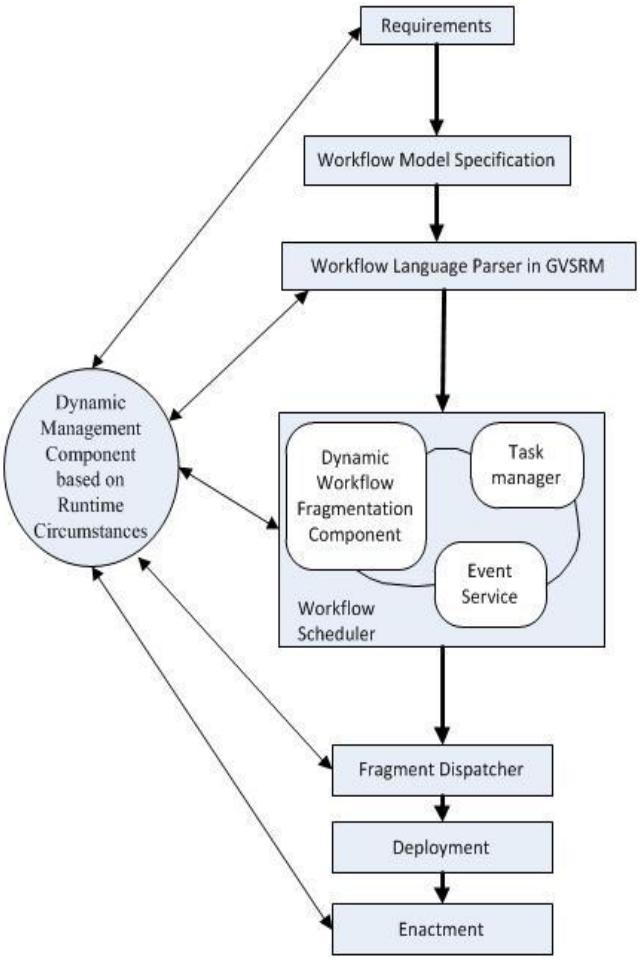

Figure4. Distributed electronic process execution framework in GVSRM

REFERENCES

[1] A. Barker," Partitioning Workflows for Decentralized Execution", Springer Science+Business Media New York 2012.

[2] A. Haque,W. Yu,A. Andersen," An Experimental Study of Centralized and Decentralized Service Orchestration Approaches", NIK 2011 conference, http://www.nik.no/,2011.

[3] A. Veenstra,M. Janssen," Chapter 10 Architectural Principles for Orchestration of Cross-Organizational Service Delivery:Case Studies from the Netherlands", Springer Science+Business Media, LLC 2011.

[4] D. Draheim," Decomposing Business Processes", A Unified View on Business Processes, Workflows and Enterprise Applications, DOI 10.1007/978-3-642-01588-5_5,Springer-Verlag Berlin Heidelberg 2010.

[5] F. Milani,M. Dumas,R. Matulevičius," Decomposition Driven Consolidation of Process Models", C. Salinesi, M.C. Norrie, and O. Pastor (Eds.): CAiSE 2013, LNCS 7908, pp. 193–207,© Springer-Verlag Berlin Heidelberg 2013.

[6] G. Pedraza,J. Estublier," Distributed Orchestration Versus Choreography:The FOCAS Approach", Springer-Verlag Berlin Heidelberg 2009, Springer-Verlag Berlin Heidelberg 2009.

[7] J. Cheng,G. Zeng," An agent-oriented approach to process partition and planning in migrating workflow systems", Engineering Applications of Artificial Intelligence, www.elsevier.com/locate/engappai,2012.

[8] J. Gortmaker,M. Janssen," Business Process Orchestration in e-Government: A Gap Analysis", 15th IRMA International Conference, New Orleans, LA, USA,2004.

[9] J. Kim,J. Eui Hong,J. Young Choi," Dynamic Service Orchestration for SaaS Application in Web Environment", *ICUIMC'12*, February 20–22, 2012, Kuala Lumpur, Malaysia ,Copyright 2012 ACM 978-1-4503-1172-4

[10] K. Kim," A model-driven workflow fragmentation framework for collaborative workflow architectures and systems", Journal of Network and Computer Applications, Journal of Network and Computer Applications,2011.

[11] L.E. Pogkas," Decentralized Business Process Execution in PeertoPeer Systems", DIPLOMA THESIS in NATIONAL AND KAPODISTRIAN UNIVERSITY OF ATHENS,2011.

[12] P. Hens,M. Snoeck,G. Poels,M. Backer," Process fragmentation, distribution and execution using an event-based interaction scheme", The Journal of Systems and Software, www.elsevier.com/locate/jss,2014.

[13] P. Hens,M. Snoeck,M. Backer,G. Poels," Decentralized Event-Based Orchestration", Springer-Verlag Berlin Heidelberg 2011, LNBIP 66, pp. 695–706, 2011.

[14] R. JAYAPRAKASH,M. SHANMUGAM,P. MANIKANDAN,S. SHIVARAJ," Decentralized Service Orchestration by Continuous Message Passing", (IJCSE) International Journal on Computer Science and Engineering Vol. 02, No. 05, 2010, 1627-1632.

[15] S.Hashemi,M.Razzazi,"Global Village Services as the future of electronic services :Streamlining the Global Village Services instead of E-Governments', E-Businesses', and E-Commerce' Services", LAP LAMBERT Academic Publishing,2011.

[16] S. Zaplata,K. Kottke,M. Meiners,W.Lamersdorf, " Towards Runtime Migration of WS-BPEL Processes", Springer-Verlag Berlin Heidelberg, 2010, LNCS 6275, pp. 477–487.

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