Event Semantics in Event Dissemination Architectures for Massive Multiuser Virtual Environments

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ABSTRACT

As distributed applications in many domains grow more and more to a global scale, *Massive Multiuser Virtual Environment*s (MMVEs) emerged in the gaming industry over the last years with an enormous monetary impact. Current architectures use centralized approaches, which obviously do only scale to a certain point. As recent research in this field has shown, the potential to improve scalability beyond this point rests in distributed event based architectures as well as the exploitation of event semantics to optimize these architectures. In this paper, we propose an event classification aimed at exploiting event semantics for performance optimization of MMVE architectures.

1. INTRODUCTION

PricewaterhouseCoopers (PWC) forecasts a doubling of the market volume for computer and video games in 2010 up to 2,6 billion Euro [10]. The most growing market in this area are online games. For 2009 PWC forecasted an increase of 18 percent for online games sales. Currently over 17 million people are paying for online games.

Despite this fact, current MMVE architectures still favor a client/server architecture, mostly motivated by the fear of cheats and the easy maintainability. To cope with an increasing number of players tremendous effort is invested by the usage of grid approaches like Second Life or the deployment of large clusters like for the operation of Eve Online with a maximum of about 47 thousand concurrent players in one persistent virtual world [4]. But they are only capable of serving such numbers of players as long as they are as evenly distributed in the virtual environment as possible. When players start to flock, the servers' load reaches critical levels very fast.

The underlying architectures are mostly centralized publish-subscribe systems [6] and offer many optimization possibilities. In recent years distributed approaches are discussed in specialized MMVE research as a possible solution [9]. They all share one common goal: to reduce the effort needed for consistent updates of the distributed world state, whilst maintaining a high frame-rate of the world simulation. The initial effort is $O(n^2)$, n being the number of participating clients in the world.

A typical approach to optimize performance is to make use of application specific event semantics for efficient event dissemination. As a consequence *Area of Interest* (AoI) optimizations [3], specialized consistency models like [8] or other optimizations based on the application induced semantics are used, but all existing approaches concentrate only on one special performance aspect, not providing any underlying model describing the event semantics.

In this paper we identify some relevant event properties that can be used to semantically classify events. We thereby generalize MMVE specific approaches in existing research and try to find generally applicable dimensions of performance relevant event semantics. These dimensions provide the first step towards a generic optimizable event dissemination framework for MMVEs.

This paper is organized as follows: In section 2 we motivate our classification and describe its dimensions. In section 3 we briefly discuss the status of our project and provide an outlook on future work.

2. CLASSIFICATION

This classification of events aims for the description of semantics in distributed MMVE architectures. They use events to maintain a consistent state of the world amongst all participants, meaning ideally all events are securely delivered and processed in the same order at the same time on all clients. It is obvious that these consistency requirements have to be weakened in order to gain acceptable performance. We strive for a supporting multidimensional classification schema which models all aspects of performance relevant event semantics.

In order to specify this schema, we tried to find orthogonal dimensions. They are inspired by the features of event processing systems, as identified in [6] and incorporate recently proposed domain specific approaches for MMVEs like [7, 1, 2, 11, 5]. The goal is the generalization of the performance optimization potential. Each identified dimension has a relevant impact on the performance of event dissemination, due to their costs for guaranteeing certain event semantics. These costs for example are produced by additional events, complex processing steps or I/O operations. Following initial dimensions have been identified:

Context Each event in an MMVE has a certain context in which it is relevant or valid. This context may be spatial, social or one or more targets defined by certain metrics as in [1]. An example for an event with a spatial context is the opening of a box in the virtual environment. Only clients in visual range need to be subscribed to such an event. In general the context of an event in an MMVE reduces its recipients to

DEBS '10, July 12-15, 2010, Cambridge, UK

a certain subset. Most optimization algorithms in this field may be summarized under the topic AoI Management [3].

Synchronization Some events have certain temporal or causal dependencies and therefore require synchronization. For example a position update may have no synchronization requirements, due to its high update rate. An event representing the pickup of an item from a chest on the other hand needs defined synchronization semantics, because there are causal interdependencies if another player also wants to pick up this item at the same time. There are many different approaches like *virtual time* [8, 5], all providing different synchronization semantics for different requirements.

Persistency In contrast to normal multiuser virtual environments, MMVEs provide a persistent world, which leads to the consequence, that some events like e.g. the gain of money has to be persistent in some way. There are two major solutions to this problem: Replication of the state, to ensure enough hosts are always online to restore the state or the storage in a centralized database [11].

Security A secure event is not tempered and represents the initial event. Especially in distributed MMVE architectures it is important to at least detect cheating clients. Prevention would be the optimum, but in most cases it is too expensive to guarantee cheat-free operation. Because of its impact on the performance of event dissemination we see security of events as a semantically relevant dimension in this context.

Validity Whilst synchronization describes the order of, or more general the relationship between events, validity is strictly limited to one event, for example an effect on a player which is active for a certain time may be modelled by one event with the corresponding validity.

Delivery Some events must reach their destinations, while others like position updates may have such a high frequency, that the loss of a single event does not cause any problems. Therefore the system may have to guarantee the delivery or prioritize it. Depending on different delivery characteristics, the systems may be optimized and reduce events.

All described dimensions provide aspects to classify events regarding their performance relevant semantics and as all dimensions are deduced from existing approaches it is possible to optimize a system along these dimensions. For example the event "player A gives player B item X" can be classified as an event with guaranteed delivery, unlimited validity, cheat-preventing security, full persistency and single target context. With this classified event type at hand, we may optimize its dissemination throughout the system based on the most appropriate combination of algorithms for this class.

3. DISCUSSION AND FUTURE WORK

In the domain of distributed MMVEs a lot of work has been done on optimization, due to the demanding requirements of multiplayer games. Yet, to the best of our knowledge, all existing approaches concentrate on exploiting just a few promising semantic aspects of events and are far away from providing a uniform framework for semantic event classification and adaptable event dissemination characteristics. We strive for such a framework, in which it should be possible to model the semantics for each event type and define performance requirements of the application in order to enable the system to optimize itself. We have identified major dimensions for semantic classification as presented in this paper. Our current research focuses on refining the classification schemas for each dimension. To verify the relevance and practicability of our findings we are currently analysing different games and classify their event types along our multidimensional classification schema. In future, we plan to extend the resulting dimensions and classes to a formal semantic model. Together with a corresponding cost model it will support a customized optimization for application-specific requirements. Furthermore, we intend to implement a prototype framework for event dissemination based on our performance model. We understand the work presented in this poster as a first step on the road to generic event dissemination systems which are optimizable based on the knowledge of application semantics.

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