



Event Semantics in Event Dissemination Architectures for Massive Multiuser Virtual Environments

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Scenario

Massive Multiuser Virtual Environments (MMVEs):

Massive A certain scale has to be reached. Current Architectures serve up to 50.000 users in one world [1].
Multiuser It is a distributed application with multiple users, which are represented by interconnected clients.
Virtual Environments The system simulates a persistent world in real-time.

In MMVEs thousands of players share and compete in one persistent world. From a scientific point of view such a system is conceptually a discrete event based simulation in a distributed environment. Therefore the state changes of each client is published via events and the corresponding server computes consistent world states from those events, which are then published back to the clients via events.

In most MMVEs, the chosen event processing paradigm to implement those systems is a distributed publish/subscribe concept. This is the conceptual background under which we examine performance optimization under exploitation of event semantics.

Problem Statement

Without any optimization, the initial effort for the computation of a consistent state in an MMVE is $O(n^2)$, n being the number of clients and therefore also the number of messages considering broadcast semantics. Obviously this effort does not scale well. Therefore many optimization approaches have been proposed to reduce the number of messages needed. All of these approaches exploit the semantics of the events in some kind.

The key to large scale MMVEs to our believe lies in the minimization of the events needed to compute a consistent world state. Our approach aims for a framework for exploitation of event semantics to minimize required messages.

Centralized vs. Decentralized Architectures for MMVEs:

Client/Server Architectures: Current state of the art. These architectures only scale to the current level by usage of different optimizations:
-Cluster and Grid approaches (e.g. partitioning of game world via shards and regions).
-Gameplay optimization (e.g. low simulation frame rate).
-Event dissemination optimization (e.g. area of interest management).

Hybrid/P2P Architectures: Addresses the problem of scalability further. Resources of clients are used to scale beyond centralized approaches by exploitation e.g. of the locality of messages or the circumvention of physical limitations as well as the lower maintenance costs in contrast to a large cluster. But this approaches also have new introduced complexity, as clients may disconnect or be compromised.

In order to enable the development of a framework for optimization based on event semantics, we use a P2P based architecture, as a client/server system in our case is only a degenerated decentralized architecture.

Existing Approaches

We examined some existing P2P based approaches for MMVEs in respect to our classification. Each approach is denoted, whether it provides an optimization mechanism of some kind for the corresponding dimension of our classification. As the table shows, there is no approach, considering all proposed dimensions, despite their relevance in optimization of MMVE architectures.

	Context	Persistence	Synchronization	Validity	Delivery	Security
SimMud [8]	x	x				
Colyseus [4]	x		x			
VON [2]	x					
Rokkatar [9]	x					
Donnybrook [3]	x					
Virtual time [7]			x			
Ferretti [6]			x			
Dead Reckoning [12]					x	
Kabus [11]						x
Mammoth [5]		x				
MiddleSIR [10]		x	x			

Exemplary Classification

We give some common event type examples for MMVEs based on an analysis of the events used in Quake 3 Arena. An exhaustive classification is not possible at this point of our research. Each event type is classified along each dimension and associated with a certain class depending on available optimization strategies. Following selected event types have been found in the Quake 3 Arena source code (Q3A 1.32b Source Code: <http://www.idsoftware.com/business/techdownloads/>) and exemplary classified:

Movement events have a spatial context, transient persistency, causal synchronization, interval validity, desired delivery and no security.

Jump events have a spatial context, transient persistency, causal synchronization, interval validity, guaranteed delivery and preventing security.

Item Pickup events have a spatial context, persistent persistency, sequential synchronization, unlimited validity, guaranteed delivery and preventing security.

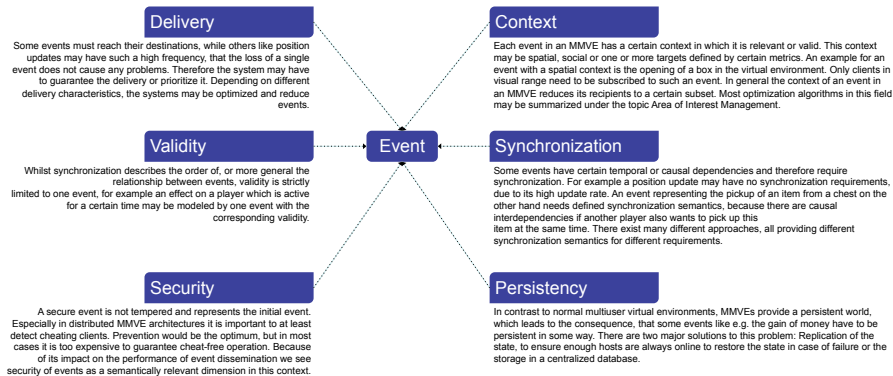
Team Message events have a multi-target context, transient persistency, weak synchronization, unlimited validity, desired delivery and no security.

Event Semantics

In order to exploit event semantics we strive for a multidimensional classification schema. To achieve this, two steps are required:

1. Identify all relevant dimensions of event semantics.
2. Define disjoint classes along those dimensions with corresponding optimization methods.

Following initial dimensions have been found for the domain of MMVEs:



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