CLOUD BASED SEMANTIC EVENT PROCESSING FOR MONITORING AND MANAGEMENT OF SUPPLY CHAINS

A VLTN White Paper

Dr. Bill Karakostas

Bill.karakostas@vltn.be

Executive Summary

Supply chain visibility is essential for resilient and adaptive supply chains. Event-driven architectures have aimed to enhance visibility by making information about events that occur in the supply chain available to decision makers in almost real time. However, current event-driven architectures only work best for fixed supply chains and are very hard to adapt to handle very large volume of events occurring anywhere in the supply chain, and for dynamic supply chains. This paper explains how the confluence of two technologies: the Semantic Web and Cloud, can help to overcome such limitations and to create event driven architectures where important event patterns are detected instantly, as they form, in the supply chain and their presence informed to all interested parties, without the need for setting up dedicated system and data connections.

Event Driven Information System Architectures

Event-driven architecture (EDA), in a distributed environment such as a supply chain, is an asynchronous message-driven communication model to propagate information. In an event-driven architecture, information can be propagated in near-real-time and enable the participant organizations to proactively respond to business activities. Event-driven architectures improve on traditional data integration techniques such as batch-oriented data replication and business intelligence reporting. Concepts related to it, include business activity monitoring (BAM) and business event management (BEM).

The event-driven pattern logically decouples connected systems, compared to the client server (request/response) pattern. That is, processes in the sender system, where the business event took place, do not depend on the availability and completion of processes in systems further down the line. In contrast, in a request-driven architecture, the sender system needs to know exactly what the provider systems are and depends on their availability.

Complex Event Processing

The term Complex Event Processing (CEP) refers to the abstraction technique, where sets of low-level events are aggregated by means of event pattern (rule) descriptions, into abstracted 'high-level' events that make sense to a business user. There are several commercial and prototype event engines that can process rules to detect complex, high level events. The problem these technologies face however is that they have to work with precise, well defined and complete low level events. Thus, classical CEP technologies cannot *semantically* interpret and analysing low level events- they require highly structured data with

well-known interpretations. In many supply chains, however, it is simply not possible to know the structure and meaning of *all* occurring events.

Semantic Technologies for Event Processing

Because the event producer and consumer(s) do not have to be known to each other, and to agree on event classification and meaning, the producer must send out event information either as metadata or as links to other known data that can be semantically processed by the consumers. Metadata attached to the event can refer to an ontology or industry schema such as for example, from ISO or OASIS. Semantic approaches to CEP detection work by analysing the semantic relationships between atomic events in order to detect meaningful patterns among them. Event patterns need to be learnt before used. Semantic relationships can be discovered by exploring ontologies in terms of which are defined. If such explicit information is missing, other contextual event information is utilised such as temporal, location, etc. Thus, several techniques, in addition to predefined CEP patterns, can be employed such as machine learning and other statistical approaches. Unknown patterns can be also detected as anomalies, and sent to expert users who can analyse their meaning and significance.

Event Harvesting from the Cloud

The main problem of CEP approaches in a dynamic Cloud environment is not how to detect the events but how to interpret them. Events are conveyed in many forms such as in business messaging system, emails, RSS feeds, and so on. Classic CEP technologies however, require well-structured data, known vocabularies, and static queries. In the Cloud, the availability of published ontologies facilitates the automatic

processing of event data. Techniques borrowed from the Big Data area, such as advanced statistical and textual analyses, as well as temporal and spatial reasoning can also be utilised for this purpose.

Security

Security in event-driven architecture is usually built on the same technologies and infrastructures used in service-oriented (SOA) architecture implementations. However, because of the highly decoupled nature of event-driven patterns, event-based security can be simpler compared to the end-to-end security required in request-driven distributed systems. Events are simply notifications of significant changes, and there is no need to transmit important data as events over the network. This means that only the meaningful data that uniquely identifies the change the event is notifying about should be part of an event payload, to help event receivers decide how to react to the event.

Benefits for logistics organisations

In supply chains where the data and context of available events is highly heterogeneous, a much less structured form and approach than those of the classic CEP technologies must be used. Cloud based semantic event processing technologies allows visibility across highly heterogeneous and dynamic supply chains. Cloud based semantic CEP realises the promises of classic CEP such as

Reduced information latency—Event notifications can ripple throughout the supply chain in near real-time. This allows supply chain participants to be proactive.

Timely response to changes—As business-critical data propagates throughout the supply chain in a timely manner, IT systems can have the

most accurate, current view of the state of the supply chain. This enables the prompt and accurate business-level responses to changing conditions.

Improved scalability—Because the CEP matching workload is not handled by a single CEP engine but by the Cloud, this approach is more scalable and can cope with practically an unlimited volume of events .

Improved flexibility-Event consumers do not rely on fixed event processing rules and patterns as well as predefined sources of events. This adds dynamicity and reduces overall complexity.

Improved supply chain agility and resilience—Finally, event-driven architecture promises enhanced business agility, as it provides a closer alignment with operational models, especially in complex and loosely coupled supply chain environments where participants have local autonomy.

Summary and Future Directions

This white paper explored Cloud and semantic technologies for leveraging the potential of Complex Event Processing and Event-driven information architectures for supply chains. Overcoming limitations of classic CEP requires the ability to process intelligently any relevant event no matter where it occurs and in what volumes. Instead of having to explicitly define event patterns and identify all possible event producers, something impossible in dynamic supply chains, we can leverage the power of Cloud and semantic technologies to create an open, dynamic and flexible event processing approach. This can achieve true visibility across the whole supply chain and consequently more effective monitoring and management.

For further information regarding topics discussed in this paper please contact the author at bill.karakostas at vltn.be