From Semantic Complex Event Processing to Ubiquitous Pragmatic Web 4.0

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Detection, prediction and mastery of complex situations are crucial to the competitiveness of networked businesses and the efficiency of dynamic distributed enterprise infrastructures in manifold domains such as Finance/Banking, Logistics, Automotive, Telco, Life Sciences. Complex Event Processing (CEP) is an enabling technology to extract actionable, situated knowledge from large amounts of event data in near real-time. This real-time behavior is considered as one of the main prerequisites for many highly relevant technology trends such as predictive business, real-time adaptive enterprise or autonomic systems. CEP is now one of the fastest growing segments in (distributed) enterprise middleware software, with products provided by major software vendors and many start-up companies around the world.

The prospect of combining event processing and semantic technologies in the area of Semantic Complex Event Processing (SCEP) is this: Event processing engines will have (1) a description of what is happening in terms of events and (process) states / situations and (2) a plan for the re/actions and processes they can invoke (often leading to follow-up events). Novel rule-based Event Processing Languages (EPLs) for the Web such as Reaction RuleML [3] employ reaction rules, which have evolved from existing rule-based technologies such as production rules and Event-Condition-Action (ECA) rules. They can use SCEP-generated knowledge to derive further decisions and trigger automated reactions. Moreover, EPLs can exploit the declarative expressiveness of semantic rules as a means to specify knowledge in a way that is understandable by 'the business' and is executable by CEP rule engines.

The notion of “event” is also becoming more and more important in Information Systems and in Business. Real-Time-Enterprise (RTE) takes the role of timeliness to its logical extreme: zero latency, that is, all parts of the enterprise can respond to events as soon as they become known to any one part of the enterprise or extended enterprise. The Event-Driven Architecture (EDA) can support increased agility: to respond to exceptions and unanticipated events at any time, even when business processes are already under way. Complex Event Processing (CEP), often related to as Business Activity Monitoring (BAM), includes tools that monitor the events in the enterprise and are not only able to aggregate data into higher-level complex events but also to detect unusual event patterns that may need an alert.

Besides many existing ontologies for events, time, space etc. and industry standards for event communication, there have been also many different approaches for rule-based event processing and reaction rule languages. For an overview on standardizations see the RuleML/EPTS Standards Reference Model [6]. As defined in the EPTS Event Processing Reference Architecture [5], events are picked up by monitoring functions, aggregated, evaluated and responded to; all these activities are steered by rules. While standards such as OMG Semantics of Business Vocabulary and Business Rules (SBVR + OMG DTV), OMG Production Rules Representation (UML modeling for production rules), and W3C RIF Production Rules Dialect (Semantic Web interchange format for production rules) focus on specific types of rules such as business rules or production rules, Reaction RuleML [3] is an overarching standard for all types of reaction rules, including rule-based CEP.

Semantic Web technology can play an important role in the further development of the Internet of Things. Given the enormous amounts of data that will be produced in this kind of things and

applications, a purely syntactic approach is too limiting in the long run. However, not only semantic but also pragmatic aspects such as dealing with context should be taken into account. The event-driven approach separates the social aspect from the physical aspect, but the social aspect, e.g. the authorization structure, still needs to be addressed, e.g. an authorization structure, or authorization governance, in terms of rules, is therefore indispensable.

This real-time event processing logic of SCEP and the real-time behavior of decision and reaction rules needs to be embedded into intelligent end-user programmable smart agents on the Pragmatic Web [8]. Such smart Web agents, with their internal and external semantic knowledge and their pragmatic rule-based decision and interactive reaction logic might lead to a transformation of the current passive Web to an ubiquitous active Pragmatic Web 4.0 [14], in which an eco-system of pragmatic agents actively supports the human and machine consumers (smart service, smart things) in their desires and needs. This new Web will be inherently event driven with loosely-coupled and decoupled interactions, but with adaptive and real-time behavior.

References:

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