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Blockchain Design and Modelling

Nicolae Sfetcu

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Nicolae Sfetcu[1]
nicolae@sfetcu.com

Abstract

Ontology engineering, along with semantic Web technologies, allow the semantic development and modeling of the operational flow required for blockchain design. The semantic Web, in accordance with W3C, provides a common framework that allows data to be shared and reused across application, enterprise, and community boundaries, and can be seen as an integrator for various content, applications and information systems. The most widely used blockchain modelling system, by abstract representation, description and definition of structure, processes, information and resources, is the enterprises modelling. Enterprise modelling uses domain ontologies by model representation languages.

Keywords: blockchain, design, modelling, ontology engineering, semantic Web, technologies, enterprise modelling

Proiectarea și modelarea blockchain

Rezumat

Ingineria ontologică, împreună cu tehnologiile Web semantic, permit dezvoltarea semantică și modelarea fluxului operațional necesar pentru proiectarea blockchain. Web-ul semantic, în conformitate cu W3C, oferă un cadru comun care permite partajarea și reutilizarea datelor peste granițele aplicațiilor, întreprinderii și comunității, și poate fi văzut ca un integrator pentru diferite conținuturi, aplicații și sisteme de informații. Cel mai utilizat sistem de modelare blockchain, prin reprezentare abstractă, descriere și definire a structurii, proceselor, informațiilor și resurselor, este modelarea de întreprindere. Modelarea de întreprindere folosește ontologii de domeniu prin limbaje de reprezentare a modelului.

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[1] Cercetător - Academia Română - Comitetul Român de Istoria și Filosofia Științei și Tehnicii (CRIFST), Divizia de Istoria Științei (DIS)

Cuvinte cheie: blockchain, design, modelare, inginerie ontologie, Web semantic, tehnologii, modelare intreprindere

Blockchain design

Ontology engineering, (Smith 2004) along with semantic Web technologies, allow the semantic development and modeling of the operational flow required for blockchain design. The semantic Web, in accordance with W3C, "provides a common framework that allows data to be shared and reused across application, enterprise, and community boundaries" (W3C 2013) and can be seen as an integrator for various content, applications and information systems. Tim Berners-Lee had the first vision of data network power (Berners-Lee 2007) processed by machines: (Berners-Lee 2004)

"I have a dream for the Web [in which computers] become capable of analyzing all the data on the Web – the content, links, and transactions between people and computers. A Semantic Web , which should make this possible, has yet to emerge, but when it does, the day-to-day mechanisms of trade, bureaucracy and our daily lives will be handled by machines talking to machines. The intelligent agents people have touted for ages will finally materialize." (Berners-Lee 2000)

Metadata and semantic Web technologies have allowed the application of ontologies for the provenance of knowledge. Computational ontology research can be useful at the economic level (including for companies), socially, and for other researchers, contributing to the development of specific applications. (Kim and Laskowski 2016)

Many researchers regard computational ontology as a kind of applied philosophy. (Tom Gruber 2008) In the paper "*Toward Principles for the Design of Ontologies Used for Knowledge*

Sharing," Tom Gruber delivers a deliberate definition of ontology as a technical term in the field of informatics. (Thomas Gruber 1994) Gruber introduced the term as a specification of conceptualization:

"An ontology is a description (like a formal specification of a program) of the concepts and relationships that can exist for an agent or a community of agents. This definition is consistent with the usage of ontology as set-of-concept-definitions, but more general. And it is certainly a different sense of the word than its use in philosophy." (Tom Gruber 1992)

To distance ontologies from taxonomies, Gruber said: (Tom Gruber 1993)

"Ontologies are often equated with taxonomic hierarchies of classes, but class definitions, and the subsumption relation, but ontologies need not be limited to these forms. Ontologies are also not limited to conservative definitions, that is, definitions in the traditional logic sense that only introduce terminology and do not add any knowledge about the world (Enderton, 1972) . To specify a conceptualization one needs to state axioms that do constrain the possible interpretations for the defined terms." (Tom Gruber 1993)

Feilmayr and Wöß have refined this definition: "An ontology is a formal, explicit specification of a shared conceptualization that is characterized by high semantic expressiveness required for increased complexity." (Feilmayr and Wöß 2016)

One of the most elaborated ontologies in this regard is the ontology of traceability (Kim, Fox, and Gruninger 1995) which helped to develop the TOVE ontologies for enterprise modeling (Fox and Grüninger 1998) considered as the main source for blockchain design.

Blockchain design is based on the fundamental principles of the Internet architecture: survival (Internet communications must continue despite network or gateway loss), variety of service types (multiple types of communications services), variety of networks (multiple types of networks), distributed resource management, profitability, ease of hosting, and responsibility in resource use. (Hardjono, Lipton, and Pentland 2018)

Blockchain models

The most widely used blockchain modelling system, by abstract representation, description and definition of structure, processes, information and resources, is the enterprises modelling. (Leondes and Jackson 1992) Enterprise modelling uses domain ontologies by model representation languages. (Vernadat 1997)

Based on component-based design, blockchain ontology decomposes blocks into functional or logical individual components, and identifies the possibilities, assisting in designing,

implementing, and measuring the performance of different block architectures. (Tasca and Tessone 2017) According to Paolo Tasca, the methodological approach is basically composed of the following steps:

1. Comparative study of different blocks: vocabulary and term analysis to solve ambiguities and disagreements
2. Definition of the framework: identification and classification of components, defining a hierarchical ontology
3. Categorization of levels: Different aspects are introduced and compared for components from the lowest level of the hierarchical structure.

Like any ICT technology, a blockchain is driven by the fundamental principles of data decentralization, transparency, security and confidentiality. (Aste, Tasca, and Matteo 2017) Other fundamental features of blockchain include data automation and data storage capability.

According to Fox and Gruninger, from a design perspective, a business model should provide the language used to explicitly define an enterprise. (Fox and Grüninger 1998) From the perspective of operations, the enterprise modelling must be able to represent what is planned and what has happened, and provide the information and knowledge needed to support operations. (Fox and Grüninger 1998) Functions are modeled through a structured representation (FIPS PUBS 1993) a graphical representation in a field defined to identify information needs, identify opportunities and determine costs. (Department Of Defense (DOD) Records Management (RM) 1995) Other perspectives may be behavioral, organizational, or informational. (Koskinen 2000)

An appropriate blockchain functional modelling focuses on the process, using four symbols for this purpose:

- Process: Illustrates the transformation from input to output.
- Storage: Collecting data or other material.
- Flow: Moves data or materials into the process.
- External entity: External to the modelling system but interacting with it.

A process can be represented as a network of these symbols. In Dynamic Enterprise Modeling (DEMO), for example, a decomposition is done in the control model, function model, process model, and organizational model.

Data modelling uses the application of formal descriptions in a database. (Whitten, Bentley, and Dittman 2004) The data model will consist of entities, attributes, relationships, integrity rules and object definitions, being used to design the interface or the database.

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