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A Temporal QoS Ontology For ERTMS/ETCS

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Abstract : Ontologies offer a means for representing and sharing information in many domains, particularly in complex domains. For example, it can be used for representing and sharing information of System Requirement Specification (SRS) of complex systems like the SRS of ERTMS/ETCS written in natural language. Since this system is a real-time and critical system, generic ontologies, such as OWL and generic ERTMS ontologies provide minimal support for modeling temporal information omnipresent in these SRS documents. To support the modeling of temporal information, one of the challenges is to enable representation of dynamic features evolving in time within a generic ontology with a minimal redesign of it. The separation of temporal information from other information can help to predict system runtime operation and to properly design and implement them. In addition, it is helpful to provide a reasoning and querying techniques to reason and query temporal information represented in the ontology in order to detect potential temporal inconsistencies. Indeed, a user operation, such as adding a new constraint on existing planning constraints can cause temporal inconsistencies, which can lead to system failures. To address this challenge, we propose a lightweight 3-layer temporal Quality of Service (QoS) ontology for representing, reasoning and querying over temporal and non-temporal information in a complex domain ontology. Representing QoS entities in separated layers can clarify the distinction between the non QoS entities and the QoS entities in an ontology. The upper generic layer of the proposed ontology provides an intuitive knowledge of domain components, specially ERTMS/ETCS components. The separation of the intermediate QoS layer from the lower QoS layer allows us to focus on specific QoS Characteristics, such as temporal or integrity characteristics. In this paper, we focus on temporal information that can be used to predict system runtime operation. To evaluate our approach, an example of the proposed domain ontology for handover operation, as well as a reasoning rule over temporal relations in this domain-specific ontology, are given.

Keywords : system requirement specification, ERTMS/ETCS, temporal ontologies, domain ontologies
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