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| Project | **Standard on Orchestration of Digital Synchronization between Cyber and Physical World**<<https://sagroups.ieee.org/2888/> **>** |
| Title | **Proposal for behavior of the digital entity associated with physical entity** |
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| Re: |  |
| Abstract |  |
| Purpose | To discuss and define the behavior of digital entity associated with physical entity |
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# Introduction

A digital twin is expressed in the digital world by abstracting the information representing the properties and behaviors of the entity in order to replicate the physical entity in the digital world. The properties of an entity represent various types of information such as identifier and relationships, and the behaviors of an entity include command data that can perform functions, actions, and works. In particular, the behaviors of an entity can be defined as several fragmentary behaviors without overlapping, and it is also possible to create new behaviors that can perform complex missions by combining these behaviors.



**Fig. 1 The concept of the behavior of a digital entity associated with a physical entity.**

Each of the behaviors defined in the digital entity should be mapped one-to-one with the functions, actions, and works included in the physical entity, and the behaviors of the digital entity can be accessed from outside the digital entity. By doing so, it should be possible to control the behavior of physical entities. when a specific behavior is called from outside the digital entity, the digital entity sends a command to the physical entity to execute a specific behavior, and then informs the final execution result again. If the property of the physical entity is changed according to a specific command while the physical entity executes the execution command, the included property of the digital entity may also be automatically changed through the synchronization mechanism.

# Behavior of digital entity

## Overview

By expressing the unique functions, actions, and works of a physical entity as behaviors on the digital entity, it is possible to control or manage the physical entity through the digital entity outside the digital entity.

* + 1. General

Describes the digital entity behaviors associated with the command data on the physical entity in the structure of the digital entity.

* + 1. Syntax

|  |
| --- |
| { "$schema": "http://json-schema.org/draft-07/schema#", "title": "Digital Thing Entity", "description": "Schema for Digital Thing(sensor device, asset, process etc.)", "type": "object", "properties": { "thingId": {"type": "string"}, "thingIdRef": {"type": "string"}, "groupId": {"type": "string"}, "accessControl": {"type": ["READ", "WRITE","ADMIN"]}, "sensorData": { "$ref": "#/definitions/sensedDataBaseAttributes" },"behaviors”: {          "type”: "object",          "properties”: {            "commandData": {"type”: "object"}          },}"$comment": "This is where the properties of each type of thing is declared by reference" }, "additionalProperties": false, "required": ["id","thingIdRef","accessControl"], "definitions": { "sensedDataBaseAttributes": { "title": "Sensor data", "description": "Schema for sensor data", "type": "object", "properties": { "timeStamp": {"type": "datetime"}, "sensorInfoBaseAttributes": { "$ref": "#/definitions/sensedInfoBaseAttributes" }, "$comment": "This is where the properties of each type of sensor data is declared by reference." }, "additionalProperties": false, "required": [ "sensedInfoBaseAttributes"], "minProperties": 2, "maxProperties": 3, "definitions": { "sensedInfoBaseAttributes": { "additionalProperties": false, "type": "object", "properties": { "id": {"type": "string"}, "sensorIdRef": {"type": "string"}, "linkedList": {"type": "string"}, "groupID": {"type": "string"}, "activate": {"type": "boolean"}, "priority": { "type": "integer", "minimum": 0 } } }, "$comment": "This is where the properties of each type of sensor data is actually defined(e.g. microphoneSensorType" } } }} |

* + 1. Semantics

| *Name* | *Definition* |
| --- | --- |
| Digital Thing Entity | Serves as the abstract basic type for implementing a digital entity that communicates with the corresponding physical entity or process in the target physical world. This type can describe a physical device, a virtual device (e.g. the weather information for specific location collected from web sites, a device that consists of the combination of sub-functions of various devices, etc), or anything that can be modeled and managed appropriately by the supported concepts/capabilities. |
| ThingId | Describes the unique identifier of a digital thing. |
| thingIdRef | Describes the reference of a ThingId as any URI. |
| groupId | Describes thingIds of the groups to which the digital thing belongs. |
| accessControl | Provides the information on accessibility of the digital thing. Also, this means the permission for accessing corresponding physical entity is same. [“READ”, ”WRITE”, ”ADMIN”]“READ” permission is allowed to read all data of the digital thing.“WRITE” permission is allowed to be able to set data of the digital thing, or send messages to the digital thing.“ADMIN” permission is allowed to modify this accessControl itself.  |
| sensorData | Dsescribes the information of the corresponding physical entity(sensor), data that can be gotten from the physical entity. |
| behaviors | Describes the command data that can perform functions, actions, and works included in the physical entity |

* + 1. Examples

{

"thingId": "KETI\_DT01",

"groupId": "KETI\_SEOUL\_G01",

"accessControl": ["READ", "WRITE"],

 “behaviors”:{

"sprayerCommandData":{

 "sprayingType": "water",

 "intensity": 45,

},

"windCommandData":{

 "intensity": 60,

}

}

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}

# Conclusion

In this proposal, we propose the concept of how to express behavioral elements such as functions, actions, and works of physical entity in the digital world. However, it does not deal with the interface contents for the execution and synchronization between digital entity and physical entity related to this.