SDF modeling for Digital Twin

draft-ietf-asdf-digital-twin-02

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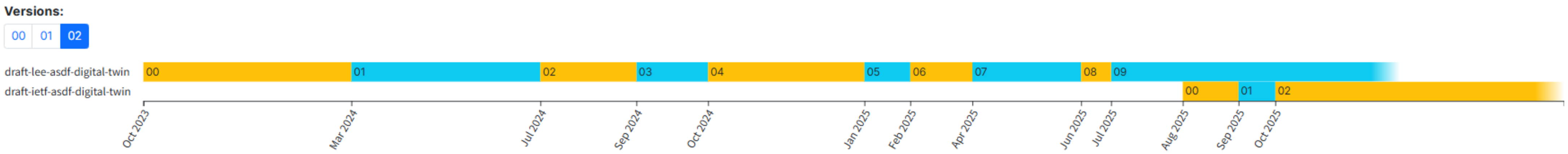
<u>Hyunjeong Lee</u> and Jungha Hong

ETRI

Status



- Changes since draft-01
  - sdfProtocolMap in Figure 2
    - NIPC and protocol mapping have been added as references.
  - Tables and a new example of healthcare system in clause 4.3
    - Add tables with components and SDF elements for each example
    - Add a new example of healthcare system
  - Changed the structure of Chapter 4 and 5

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Changes from v01 to v02

Version 01

4. Motivation and design rationale
   - 4.1. Introduction of sdfContext
   - 4.2. Digital Twin-Centric Modeling within sdfThing
5. Examples
   - 5.1. Boat modeling
   - 5.2. Relationship modeling

Version 02

4. Motivation and design rationale
   - 4.1. Introduction of sdfContext
   - 4.2. Digital Twin Modeling using elements of an SDF model
   - 4.3. Relationship modeling
5. Examples of digital twin system
   - 5.1. Overview
   - 5.2. Marine system
   - 5.3. Healthcare system

- Changes
  - Move Relationship modeling to clause 4.3
  - Move Boat modeling to clause 5.2
  - Add new example in clause 5.3

Marine Example – Boat007 (1/2)

- Boat007 example
  - illustrates a **maritime vessel with components** like
    - heater, battery, thermostat, etc.
  - Each component is modeled as an **sdfObject**, and
  - **sdfRelation** is used to express logical links like 'the heater is regulatedBy thermostat setPoint'.

- Advantages for developers and systems integrators
  - Seamlessly capture and communicate device capabilities and states.
  - Integrate operational data for real-time monitoring and analysis.
  - Enable interoperability with other domains through standardized semantics

Marine Example – Boat007 (2/2)

Attribute	SDF element	Example properties
Boat007	sdfThing	id, name, model, includes heater1 and battery1
Heater1	sdfObject	status (sdfProperty), temperature (sdfProperty), turnOn (sdfAction)
Thermostat1	sdfObject	setPoint, mode (sdfProperty)
Battery1	sdfObject	voltage (sdfProperty), chargeLevel (sdfProperty), battery-to-controller (sdfRelation)
Controller	sdfObject	status (sdfProperty), controlMode (sdfProperty)
Temp-to-Thermostat	sdfRelation	source: heater1.temperature, target: thermostat1.setPoint, relationType: regulatedBy
Battery-to-Controller	sdfRelation	source: batterySensor, target: powerController, relationType: connectedTo
Location	sdfContext	latitude, longitude, dockedAt (e.g., port007)

Table 2: Components and SDF elements of a marine system

- Relationship between components

Healthcare Example

- In a healthcare scenario,
  - we show a patient monitor composed of ECG and infusion pump.
  - The **contextual info** like patientID is modeled with **sdfContext**,
  - and **alerts** are modeled using **sdfEvent** and **sdfRelation**.”

Attribute	SDF element	Example properties
Patient Monitor	sdfThing	patientMonitor001 as a digital twin
ECG Module	sdfObject	heartRate, rhythmType, signalStrength
Infusion Pump	sdfObject	flowRate, volumeRemaining, alarmStatus
Property	sdfProperty	e.g., temperature, bloodPressureSystolic, oxygenSaturation
Context Info	sdfContext	bedNumber, wardLocation, patientID, usageScenario
Identity Info	identityManifest	systemType, firmwareVersion, hospitalAssetTag
Relations	sdfRelation	ECG → AlarmSystem (relationType: monitoredBy)

Table 3: Components and SDF elements of a healthcare system

Digital twin modeling to other SDOs

- ITU-T X.mp2p-srdtf
  - Managed P2P communications: Signalling requirements for digital twin federation
- IEEE 2888.7
  - Standard for Architecture of a Digital Twin System for Carbon Emission Management

Next steps

- Add more examples for various domains
- Apply SDF-based digital twin modeling to other SDOs
- Consider sdfInstance

Thank you!