Demo Case Update

From NTUA – National Technical University of Athens

13 September 2021

Smart Data-Models for Open-Channel (Raw-Water) system modelling, management and operation

In the framework of Fiware4Water project, NTUA develops smart applications, analytics and tools to support the Athens Water Supply and Sewerage Company (EYDAP S.A.) towards the optimal operational management of the external raw-water conveyance system that serves the city of Athens, Greece (5.000.000 inhabitants). The solutions cover both qualitative and quantitative aspects of the system, and, among others, provide advice on the optimal scheduling and operation of the regulation structures of the system, detection and early-warning of unusual qualitative events and forecasts on key control parameters of the system (e.g., water demand volumes).

To support the integration of the new analytics and web platform with FIWARE, a series of new data models were defined. This is a very first initiative to define generic data models for the raw-water (open-channel) system management domain, in the framework of interoperable and standardization principles of FIWARE.

Specifically, the following data models were defined, following the NGSI-LD specifications, to allow the digital representation of the key physical components and water-related structures of an open-channel system:

- **OpenChannel**: Description of a generic channel for a raw-water (open-channel) supply system. This entity allows the definition of a set of properties such as the characteristics and geometry of the channel (e.g., length, type of geometry, side slopes, bottom width, bottom slope, maximum allowable water depths etc.), hydraulic parameters (e.g., Manning's roughness coefficient). It also includes relationships with other physical entities to support the formulation of the topology of the system.

- **OpenChannelJunction**: This entity allows to define locations in a raw-water system where the characteristics of the channel changes, two or more channels come together or split apart, amounts of water are abstracted or inserted to the system etc. It comprises properties such as water flow inserted to or abstracted from the system.

- **CrossSection**: This entity allows to define points at a system where raw-water variables are monitored by a device and/or computed via simulation model. It comprises key hydraulic (e.g., water flow, water level, water velocity, energy head) and water quality (e.g., temperature, specific conductivity, turbidity) variables. It also allows to assign specific geometric characteristics to a cross-section of a channel.

- **SluiceGate**: This entity allows the definition of the key properties of a sluice-gate. It describes both the geometric characteristics of a sluice-gate (e.g., gate width, height, bottom elevation etc.) as well as the hydraulic characteristics of the flow (e.g., discharge and orifice coefficients to account for energy losses, water flow, energy difference etc.).

To support the modelling of flow at sluice gates, 4 relationships have been defined to allow connection with cross-sections upstream and downstream to the sluice gate, which serve as control points in a distance and near the sluice gates.

- **Spillway**: This entity allows the definition of the key properties of a spillway. The model allows the definition of characteristics (e.g., crest elevation, length, width) of different types of spillways, such as the "Broad-Crested", "Ogee" and "Sharp-Crested" spillway. Hydraulic characteristics (e.g., discharge coefficient) and design properties (e.g., design discharge, maximum flood elevation etc.) are also included.
- **RegulationStructure**: This is a junction-type entity allowing to define specialized constructions that regulate the water flow in a system. These constructions may comprise both sluice gate and spillways, such as those appear in the conveyance system of EYDAP under study.
- **OpenChannelSystem**: This entity allows to define a complete open-channel system composed by the above-mentioned works/entities and their interrelationships (e.g., channel, junction, sluice gate, spillway etc.).

Figure 1 and Figure 2 provide graphical representations of a *SluiceGate* and *OpenChannelSystem* data model, respectively, depicting the key properties and relationships.

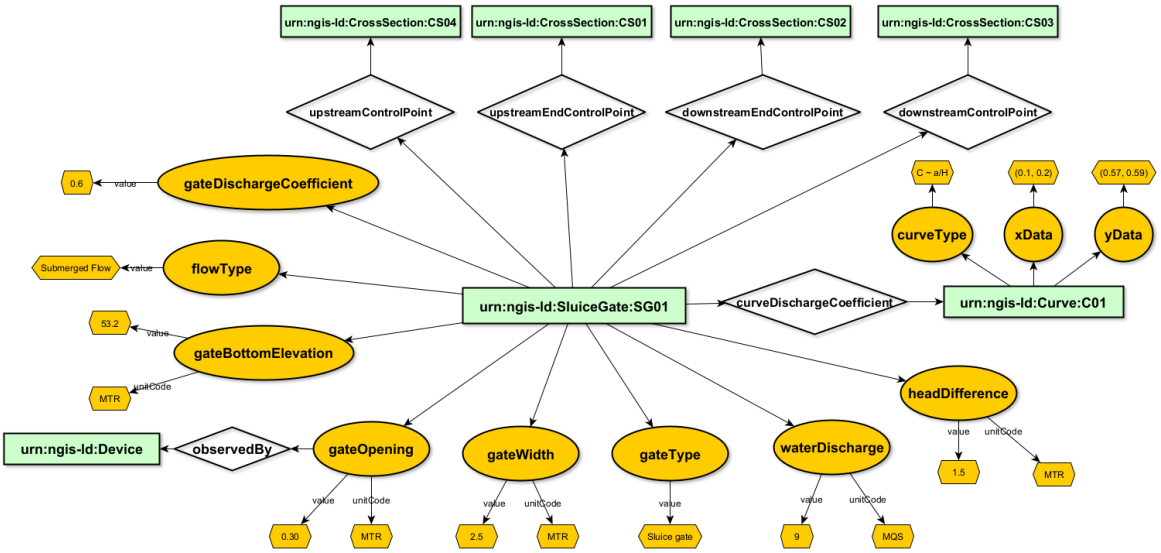

Figure 1: Sluice Gate entity (green boxes), including its properties (yellow ellipse) and relationships with other entities (rhombus).

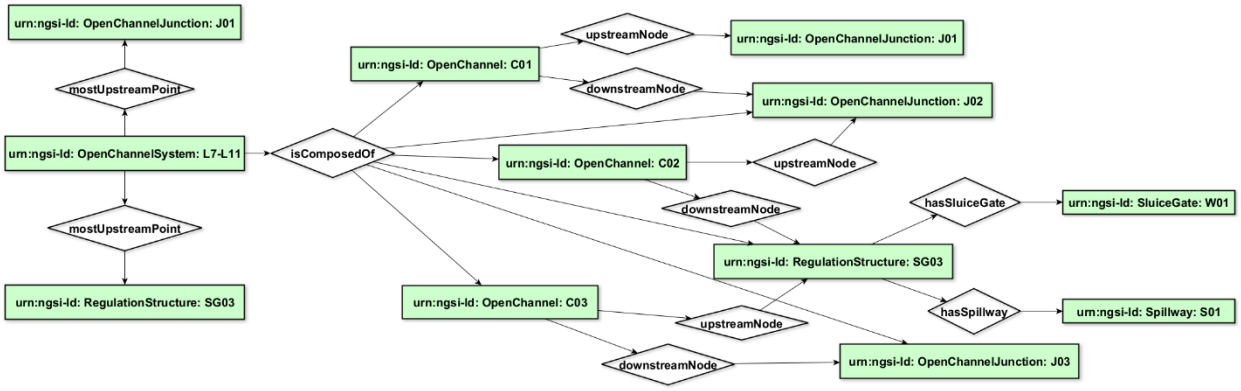

Figure 2: Graphical representation of an open-channel system (OpenChannelSystem entity) composed by channels, junctions, regulation gates and spillways.

Disclaimer

This document reflects only the author's view. The European Commission is not responsible for any use that may be made of the information it contains.

Intellectual Property Rights

Project Consortium

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant agreement No. 821036.