GEONOVUM

Geonovum Invitation to tender

Sensor data – testbed description and implementation topics

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Revision history	
Revision date	**notes**
17-3-2026	First draft
26-3-2026	Added usecase
31-3-2026	Reviews incorporated

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Chapter 1 - Introduction

This chapter gives the general background to the testbed Geonovum is organizing and specifies its goals and scope.

Invitation to tender

This document gives information about the invitation to tender regarding the following two implementation topics:

- Implementation topic #1: **Hosting a SensorThingsAPI server**
- Implementation topic #2: **Connect sensors to SensorthingsAPI server**

For topic #1 a budget of € 12.500 excluding 21% VAT is available. For topic two we are offering multiple parties € 5.000 excluding 21% VAT per party (see chapter 6).

Background

Sensor data is becoming increasingly important in the Dutch public sector. Smart cities initiatives, citizen science projects as well as nationwide sensor networks for specific tasks (e.g. environmental monitoring) have been increasing the amount of sensor data available. Being able to make sense of this data and combining data from diverse sources in applications such as digital twins increases the need to standardize sensor data.

Goal of the testbed

We want to encourage the adoption of a uniform interoperable standard for sensor data. From these adoption topics, we want to learn what the main obstacles to broad adoption of the SensorthingsAPI standard are and find ways to eliminate these obstacles.

Geonovum, in line with its mission, is keen to get the answers; and it seeks to involve the market to do so. The actual questions and issues to be addressed are described in this document, combined into two implementation topics.

Scope

In this testbed we focus on implementing the OGC SensorThings API standard. We have one use case including sensor data that can be used to help answer the questions.

Outcome

The results of the testbed are intended to contribute to expanding and innovating the Dutch public sector Spatial Data Infrastructure in a direction that takes into account the possibilities in the market today. Based on the outcome of this testbed we may take steps to make the SensorThings API standard mandatory within the Dutch public sector, in order to promote interoperability between sensor networks and encourage reuse.

To this end, implementations of standards realized within this testbed will be kept online and available for further experimentation for 6 months after the testbed ends.

This document

After this introduction, chapter 2 explains the tender procedure. Chapter 3 provides a detailed description of the available use case. Chapters 4 and 5 describe the implementation topics in detail. Chapter 6 explains the organization of the testbed in more detail. Appendix A gives the metrics by which tenders are judged.

This document is a draft. Based on questions and comments during and after the tender period, we will update this document to clarify questions and remove errors. A final draft will be made available within one week of the question period ending.

Chapter 2 - How to tender

This chapter gives information about the procedure of tender response.

Rules and procedure

The submission period for the tender starts on April 1st, 2026 with the publication of the Invitation to Tender on Geonovum's website, www.geonovum.nl.

The tender is open to private and public parties, and to combinations of parties (consortia). In the case of a consortium, there is one party who acts as the contact point and contractor on behalf of the consortium for the tender with Geonovum.

Questions about the tender can only be asked by sending an e-mail to info@geonovum.nl, addressed to Frank Terpstra, coordinator of the testbed. Questions should be submitted by Tuesday April 14th. These questions and our answers are collected in an Information Note. We will organize an informational meeting on Monday, April 13th at 14:00. Registration for the meeting can be done through the Geonovum website: Agenda | Geonovum. The minutes of this meeting will be part of the Information Note. At the latest, this note is published on the website of Geonovum on Friday, April 17th.

Your tender must be submitted by sending an e-mail to info@geonovum.nl, addressed to Friso Penninga, director of Geonovum.

The tender is preferably written in English[1] and must at least contain:

- The implementation topic or topics you are applying for;
- Motivation for the implementation topic or – topics you are applying for;
- Plan of approach for each addressed implementation topic (maximum of four pages per implementation topic);
- References (including e.g. publications, projects, blogs, code on GitHub) and curriculum vitae for performers of the research, showing enough relevant knowledge and experience;
- An indication of the in-kind investment;
- Statement of agreement with the publication of the research results and deliverables under a CC/by license.

All testbed outcomes will be available under http://creativecommons.org/licenses/by/4.0/. Deliverables of the implementation topics, in the form of published data, vocabularies, demonstrators, prototypes and the like, must remain available for at least six months after completion of the testbed.

All source code is preferably available under a "popular and widely used or with strong communities" open-source license as identified by the open source initiative. The use of other (non-opensource) licenses will be considered only if well motivated.

The deadline for submitting a tender is Friday, May 1st, 2026.

Geonovum will judge the received tenders in the first week of May (May 4th-8th), according to the criteria stated in appendix A.

[1] The alternative is Dutch

Parties are allowed to tender for more than one implementation topic. However, a contractor is only awarded one implementation topic, not several. The reason for this is our wish to gain different insights from different parties. The only exception to this rule is that additional implementation topics can be awarded to a single party if this party is the only bidder for an additional topic. We will only do this if the bidder agrees.

Geonovum will announce which party is selected for which implementation topic on May 8th at the latest. All parties who have submitted a tender will be informed about this via e-mail.

Note that reviewers of this document and Geonovum staff[2] are exempt from bidding.

Chapter 3 - Use case

This chapter describes the use case that can be employed within the testbed. It is provided as inspiration; you are free to re-use it but can also provide your own. The first phase of testbed execution will leave room to make detailed plans on interaction between implementation topics.

Use case #1: Wastewater cleaning digital twin

The water authority Brabantse Delta is building a digital twin for their wastewater treatment chain development project. They currently have a physical test setup and existing infrastructure based on node-red to make a digital twin for this. The goal of this digital twin is real time process control, monitoring and optimization of the supply chain and treatment of waste water. An important method is the optimization of water pumps using a method called convex curves for controlling when and at what speeds these pumps run. General objectives for which this setup is actively used:

- Testing architecture and software freely without consequences.
- Building and testing load-balancing controls across the supply chain.
- Researching and building control systems to increase efficiency across parallel machines with a convex curve.
- Building and testing predictive maintenance using basic sensors that are already present.
    - Answering questions like: "how can we use basic sensors to build pump curves in real time?"

The Specification of their current digital twin can be found here: https://gitea.wbd-rd.nl/RnD/EVOLV/wiki.Within their setup, there are two pressure sensors, a flow sensor, and sensors within the pump. The pump outputs in modbus, the other sensors are completely analog. Attached is a zipfile with available specifications. The water authority would like to use OGC SensorThingsAPI to collect sensor data and query the sensor data. The water authority will provide a clean FROST server SensorThings API (https://github.com/FraunhoferIOSB/FROST-Server) installation on a hosted docker container. Access to this server can be provided to participants.

[2] Employees and Secondments

Chapter 4 - Implementation topic #1: Hosting a SensorThingsAPI server

4.1 Goal

We want to have one central server available within the testbed where sensor data is gathered and made available for analysis. To be able to store all available sensor data a data model needs to be implemented within the server that can accommodate all participating sensors.

4.2 Description

Host a SensorThings API server based on the latest version of the OGC sensorthings API standard.

4.3 Task

- Create a model based on the Observations Measurements and Sampling (OMS) standard that accommodates all sensors used in this testbed
- Configure the server to work with this model and the sensors used in the testbed
- Document on how this process works such that it can be easily reproduced generically by others for other use cases
- Create and publicly demonstrate the use of this server with queries relevant to the use case
- Document lessons learned

4.4 Deliverables

- A written report. Geonovum will provide a Github repository where the report can be added in markdown format. We will act as editors and consolidate all reports into one Respec/HTML document.
- If any software is developed, this should be made available in an opensource repository and pull requests to existing OS projects in case these are used. When expanding on the Brabantse Delta software git access can be granted to participants for direct participation.
- When not using the provided server form Brabantse Delta, a server running the PoC should be kept available for the public at least until 6 months after the testbed ends.

4.5 Requirements / standards / Open Source software

Mandatory Standards:
OGC sensorthings API standard
Observations Measurements and Sampling (OMS)

Optional available Open Source Software:
For OGC SensorThings API an opensource client and server implementation is available:
https://github.com/FraunhoferIOSB/FROST-Python-Client
https://github.com/FraunhoferIOSB/FROST-Server
https://github.com/securedimensions/FROST-Server-PLUS

The above software is listed for convenience; there may be more available. The use of opensource software is preferred but not mandatory.

4.6 Relevant use cases

The reuse of the provided wastewater cleaning use case is highly encouraged. Use of your own hosted server environment and alternative OGC SensorThings API implementations are allowed.

Chapter 5 - Implementation topic #2: Connect sensors to SensorThings API server

5.1 Goal

Within the public sector many different sensors are used. There is great value in having them connect through a single interoperable standard. This makes sensor data easier to access and analyse. We want to encourage parties within de DTaaS eco system to expose their sensors using the OGC SensorThings API standard and connect them to a central SensorThings API server.

5.2 Description

Modify an existing (set of) sensors such that they can send their observations to a central OGC SensorThings API server. The way this is done is up to the participant. For instance, this can be done by directly letting each sensor connect to the server or by letting multiple sensors connect through an intermediary translation solution.

5.3 Task

- Connect one or more existing sensors to the SensorThings API server
- Validate the accuracy and reliability of the solution
- Provide a description that makes your approach reproducible for other use cases
- Document lessons learned
- Provide a public demonstration of your solution

5.4 Deliverables

- A written report; Geonovum will provide a Github repository where the report can be added in markdown format. We will act as editors an consolidate all reports into one Respec/HTML document.
- If any software is developed, this should be made available in an opensource repository and pull requests to existing OS projects in case these are used. When expanding on the Brabantse Delta software git access can be granted to participants for direct participation.
- The solution should be kept available for the public at least until 6 months after the testbed ends.

5.5 Requirements / standards / Open-Source Software

Mandatory Standards:
OGC sensorthings API standard

Optional available Open Source Software:

- FROST-Client is a Java client library for communicating with a SensorThings API compatible server.
- Geodan SensorThings .NET SDK makes it easy to add OGC SensorThings support to your .NET application.

The above software is listed for convenience; there may be more available. The use of opensource software is preferred but not mandatory.

5.6 Relevant use cases

The reuse of the provided wastewater cleaning use case is highly encouraged. Use of your own sensors is also allowed: it is encouraged that they be relevant for or useable within the provided use case.

Chapter 6 - Testbed organization

This chapter describes the organization, conditions, finance and planning of the testbed.

6.1 Coordination

The coordinator from Geonovum is Frank Terpstra (Geonovum), with support roles for:

- Linda van den Brink (Geonovum)
- Bart de Lathouwer (Geonovum)

For every implementation topic there is a bi-weekly meeting between Geonovum and each contractor, either at the Geonovum office in Amersfoort or online. The agenda items of these meetings are the progress and any issues or technical questions concerning the details of the implementation topic.

6.2 Open testbed sessions

Work on the implementation topics will be carried out in parallel. During this time, Geonovum wants the implementation topics to inform each other as much as possible. We expect there to be around 6 parallel implementations, one server and five clients connecting sensors to the server. For this reason, Geonovum will organize three sessions (max. 1/2 day each) with the contractors of all implementation topics. This will be done for the purpose of aligning and sharing developments and knowledge between the implementation topics.

These sessions will be public; the contractors will present their intermediate results to each other and an open group. Anyone who is interested can be present at these meetings. This group has the possibility to discuss in an open way the results with the contractors. The insights gained from this will be used as much as possible by the contractors in their further work on the implementation topics.

In addition to these meetings, Geonovum will organize a larger public session after completion of the testbed, in which the contractors have the opportunity to present their final results.

6.3 Planning

Geonovum will announce which party is selected for which implementation topic on May 8th at the latest (see chapter 2). The testbeds starts immediately afterwards, as do the bi-weekly meeting between Geonovum and each contractor.

The open testbed sessions with contractors will take place in the middle of May, June and July.

In May we will focus on synergy between the contractors and the use case they implement. June will focus on realization and in July the focus will be on reporting results.

6.4 Finance

For topic #1, server implementation, a budget of € 12.500 excluding 21% VAT is available. This will be awarded at most once.
For topic #2, connect sensors, we intend to award multiple participants. Our aim is to have at least five. A budget of € 5.000 excluding 21% VAT is available for each awarded contractor.

These budgets are intended as a contribution towards the research activities of the contractor. The budgets allow each contractor to carry out research and exploration activities and to develop demonstrators to try things out. The budget is not supposed to cover the entire research activities of the contractors; an in-kind contribution of the contractors is expected.

Appendix A: Metrics

The criteria by which tenders are judged are:

- The quality of the plan of approach.
- The quality of the references and CVs.
- Affinity with data (publication).
- Impact on existing workflow in terms of quality, cost, etc. and general architecture.
- Contributions towards EU and NL govt. information services and flows.
- Planned dissemination of the created work; documentation and `how to' documents, publication strategy relative to the community, licenses used.

Tenders are judged by two metrics: a general score against the key goals of this document (75%), and a further 25% for key elements specific to each of the testbeds.

All tenders will be scored according to the following metrics:

		Weight
Overall	Contribute to the "Goal of the testbed"	10%
25%	Applicability to the "Scope" as defined	5%
	Further open standards and interoperability	10%
Architecture	Re-use of or relevance to provided use case	10%
20%	Re-useability after testbed ends	10%
Proposal	Plan or approach	10%
30%	Conciseness and specificity of the plan	5%
	Portfolio, References and CV	5%
	Dissemination, Licenses, lasting effect of outreach beyond geo community	10%

A further 25% is awarded for each of the testbeds specific key goals:

Specific	1: Hosting a SensorThings API server	25%
25%	2: Connect sensors to Sensorthings API server	25%

In tenders for topic #1, the Sensorthings API server, we will look specifically at how successful we think the modelling approach will be, as well as the approach being a fit to the use case, but also in generic terms maximal learning about the combination of timeseries data and OGC sensorthingsAPI.
For the connect sensors topic we will potentially be awarding multiple participants, we are looking at diversity of approaches: we want to maximize what we learn so will most likely not award the same approach twice.