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Low-cost water level monitoring for flood management with Guerilla Sensing

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10.06.2026

Threat of flooding

Ahrtal flood disaster 2021 [4]

[2]

Oldenburg flood 2023/24 [2]

[3]

[1]

[1]https://www.oldenburg.de/fileadmin/_processed_/9/9/csm_Arbeiten_Sandkruger_Strasse_5_Stueber_95a6769599.jpg
[2]https://www.oldenburg.de/fileadmin/_processed_/6/1/csm_DJI_20240101145635_0015_V_230ea5d50e.jpg
[3]https://www.oldenburg.de/fileadmin/_processed_/e/3/csm_IMG_7595_d5e7686f18.jpg
[4]https://cdni-pageflow.wdr.de/main/image_files/processed_attachments/000/026/621/v3/large/WDR -Bild_38080487_CROP.JPG

Threat of flooding

Water level as key parameter for predicting flood-related problems, providing immediate support to emergency personnel, and reducing flood damage.

- Timely information:
  rapid changes through upstream rainfall and tide cycles
- Distributed information:
  rivers, tributaries, drainage, ground water
- **Environmental information system**…
  …commercial water level solutions can cost **15.000€ - 200.000€** per node [1].

Goal: Low-cost water level monitoring system

Guerilla Sensing and OIDD

Goal: Low-cost water level monitoring system

Stadt Oldenburg [1]

OIDD

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Guerilla Sensing

[1]https://www.oldenburg.de/_assets/d51d5b1ffc2849ec04f63985bc7d752e/Images/Logo.svg

Low-cost water level monitoring

Goal: Low-cost water level monitoring system

Data Quality

Comparable to commercial solution

Communication Quality

Reliable enough to avoid critical gaps

Autonomy

Continous operation even through seasonal extremes

Cost

Cost scales better with number of nodes than commercial solution

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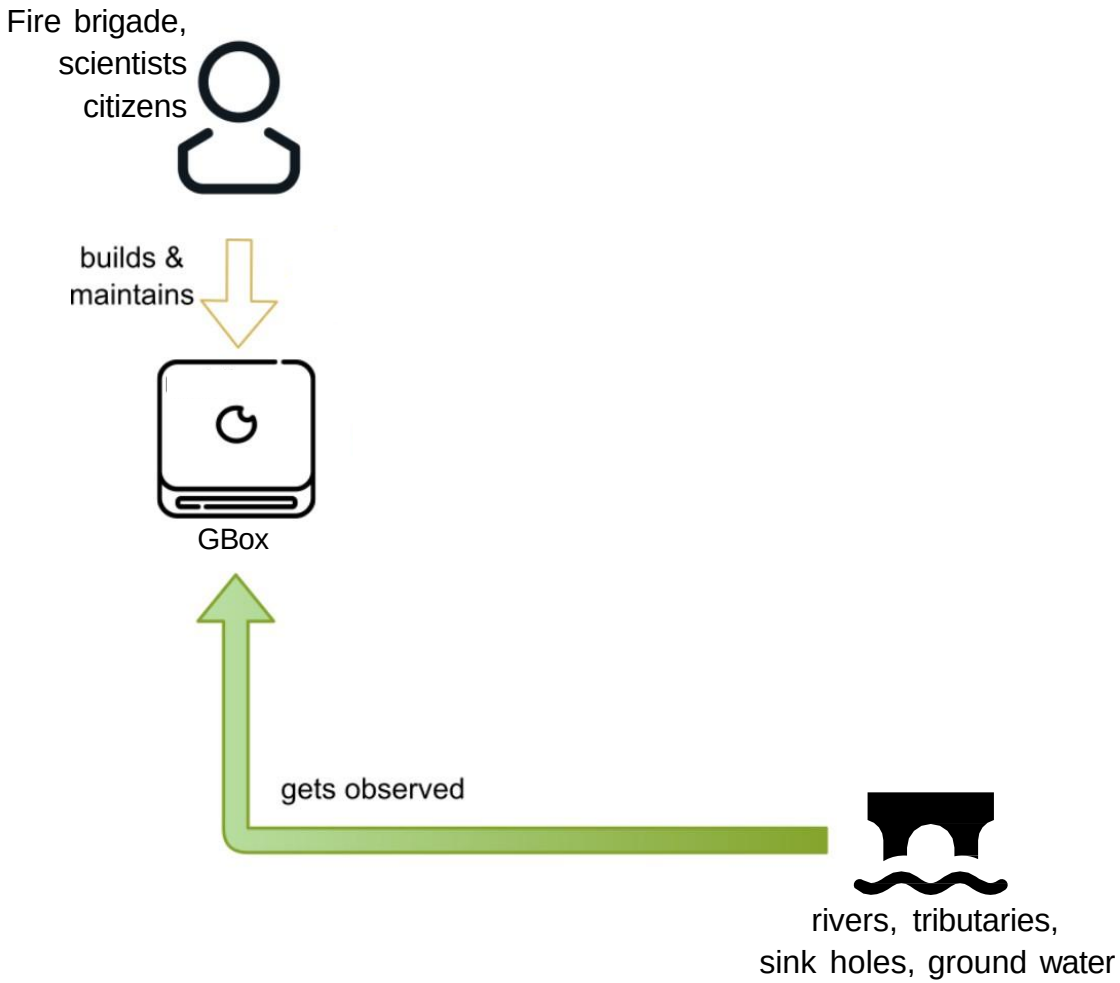
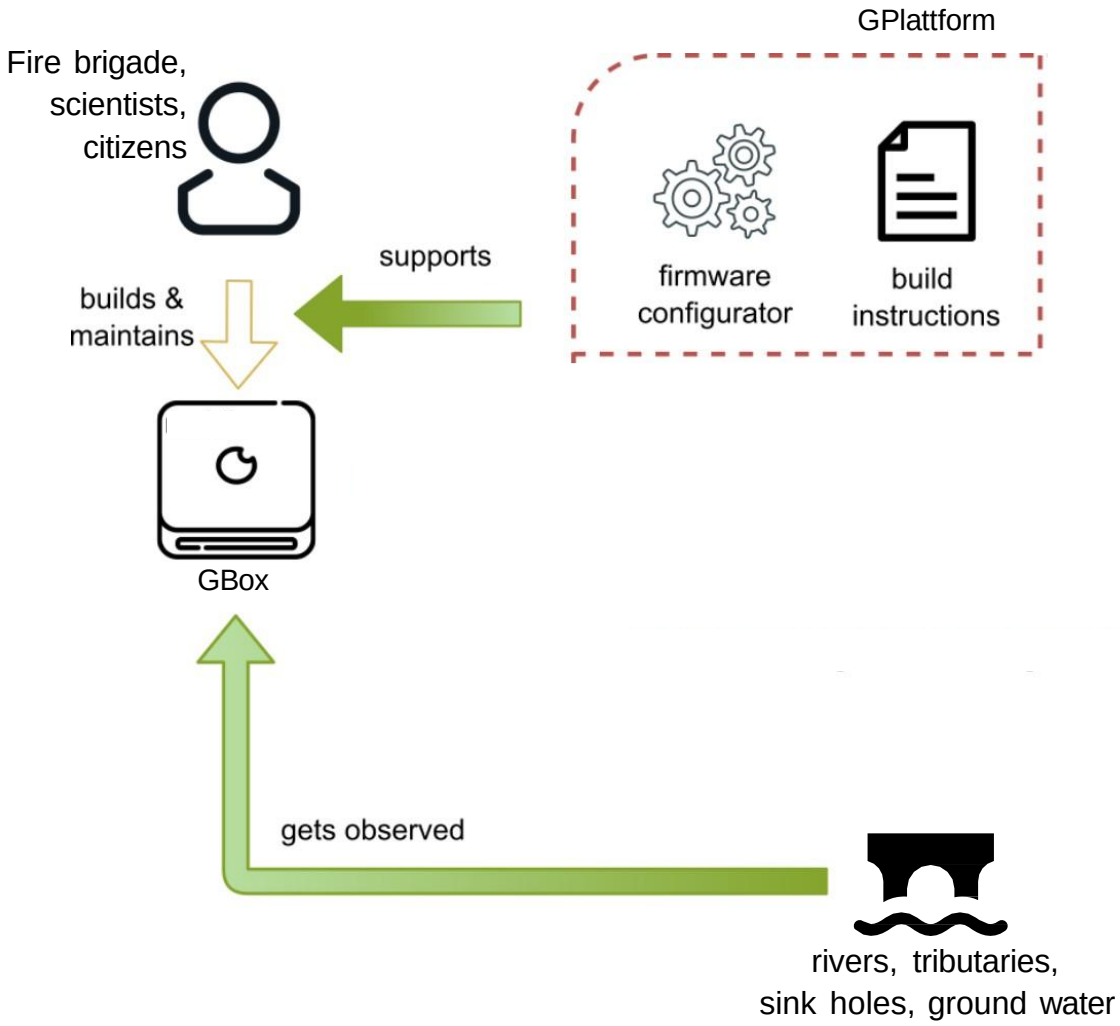
Guerilla Sensing



Guerilla Sensing



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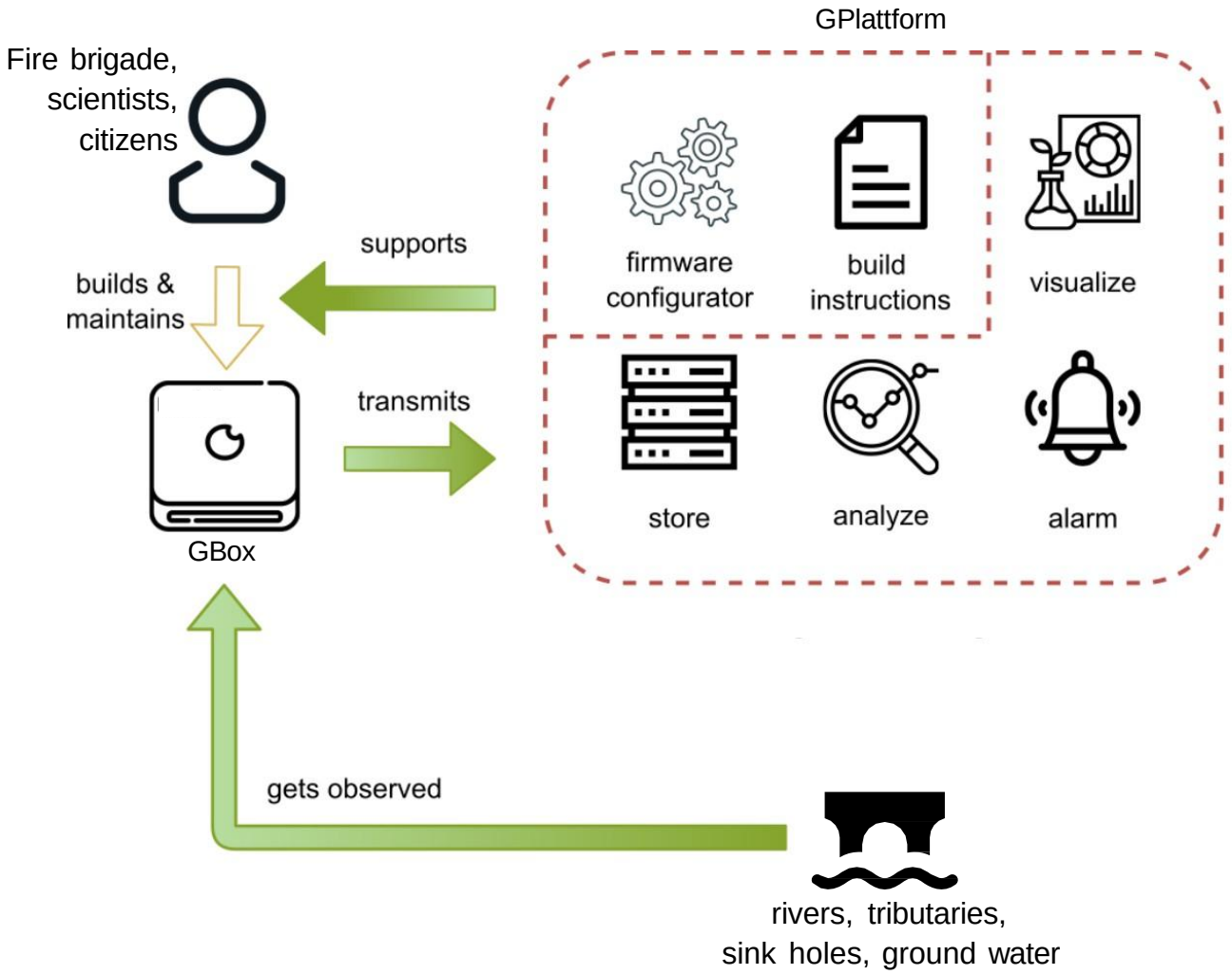
Guerilla Sensing



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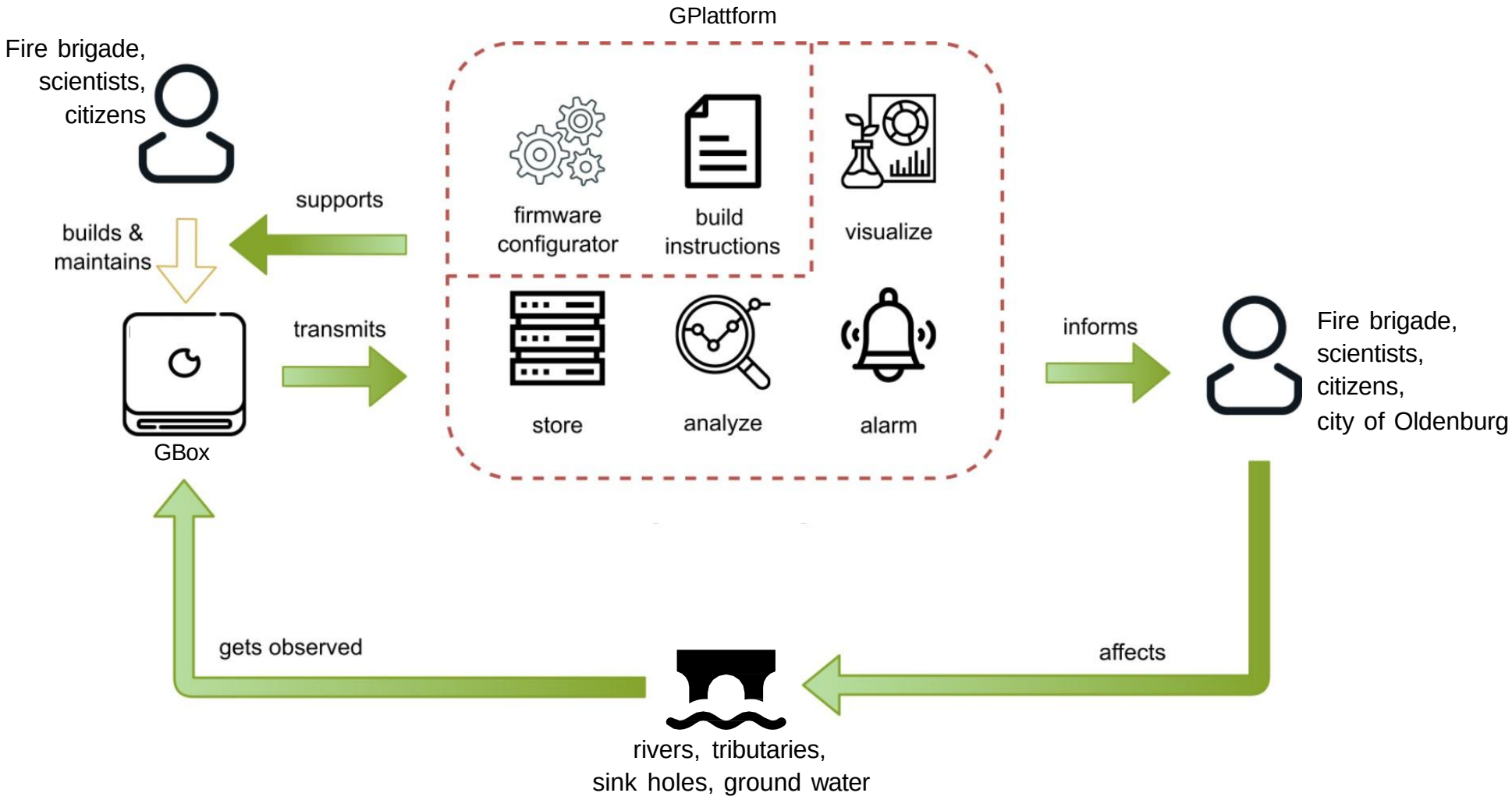
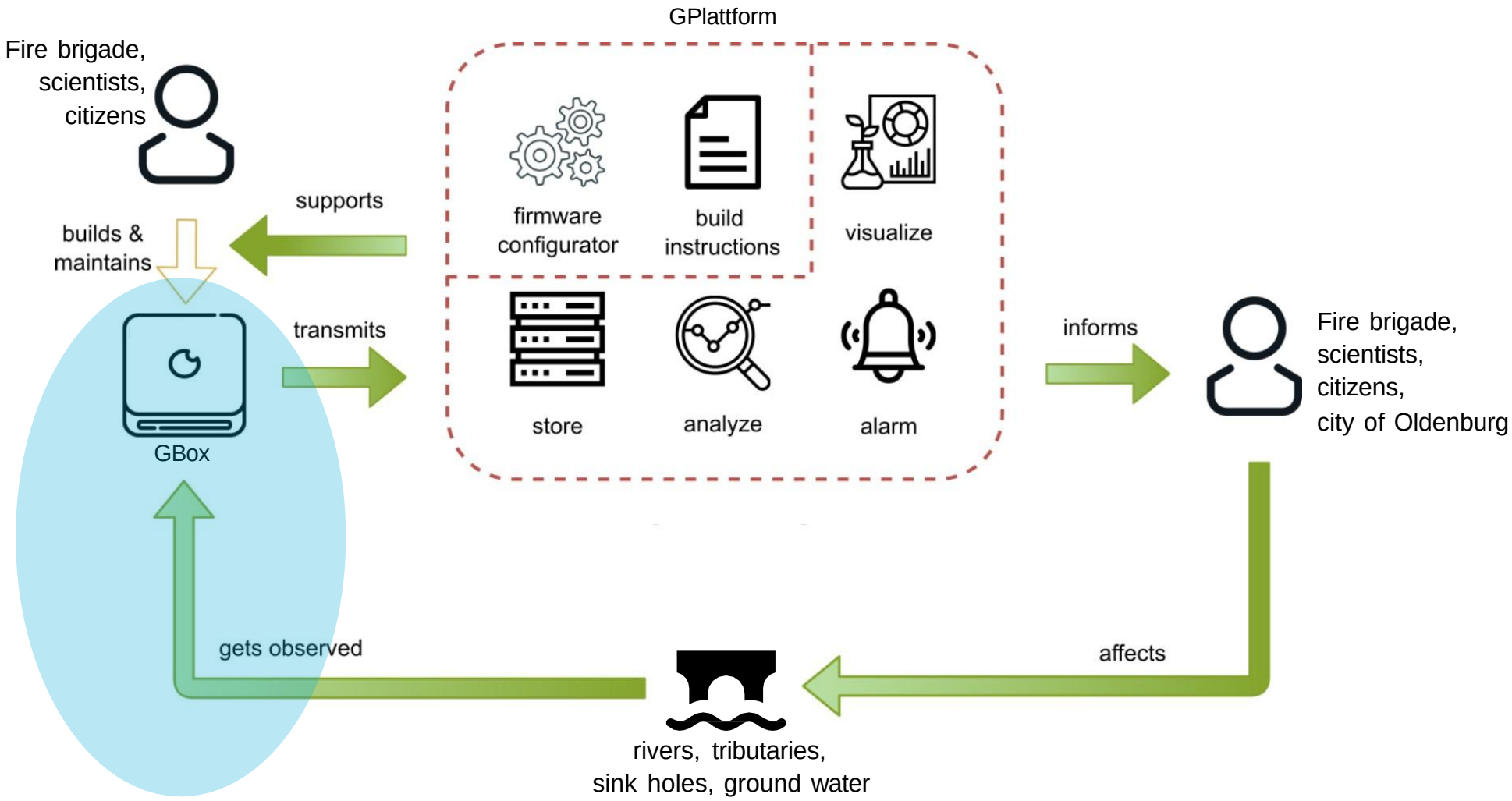
Guerilla Sensing

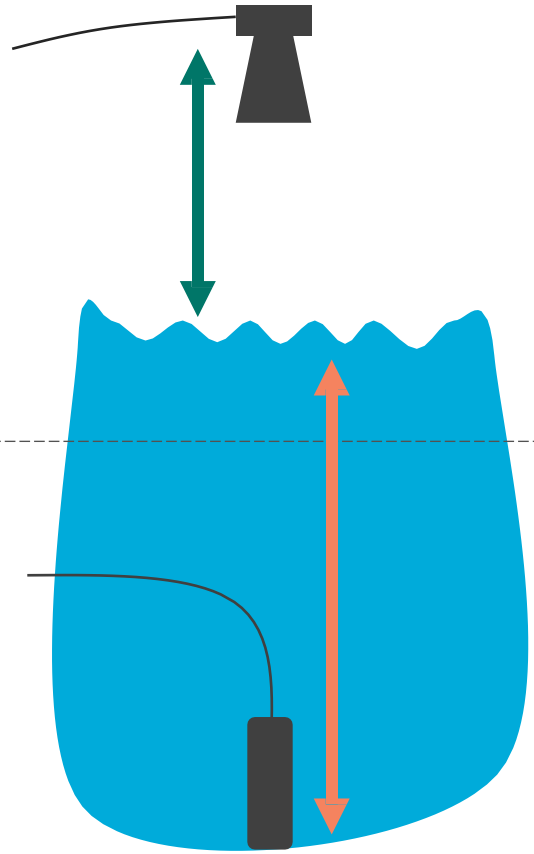


Guerilla Sensing



Water level measuring method

Ultrasonic distance



+ Low profile, easy to install
+ No contact to water

- Needs wide, free space above water
- Obstruction by insects or flotsam

[2]

A01NYUB

~40€

Hydrostatic pressure

+ Narrow spaces (e.g. sink hole)
+ Unaffected by surface conditions

- Spacial requirements
- Limited by cable length

[1]

TL-136

~40€

1 https://m.media-amazon.com/images/I/51nJMwuriAL._SL1500_.jpg
2 https://cdn1.botland.de/69261-pdt_540/ultraschall-abstandssensor-a01nyub-28-750cm-wasserdicht-dfrobot-sen0313.jpg

Communication method

	Availability	Reliability	Efficiency	Cost
WiFi	-	+	-	+/-
LTE	+/-	+	-	-
[1]	+/o	o	+	+/o

+ satisfies requirement

o partly satisfies requirement

- does not satisfy requirement

[1]https://www.semtech.com/uploads/images/LoRa_Web_Home_LoRaWAN.png

Hardware platform

Circuit board **15€**
integrated MOSFETs cut
power of perifphery

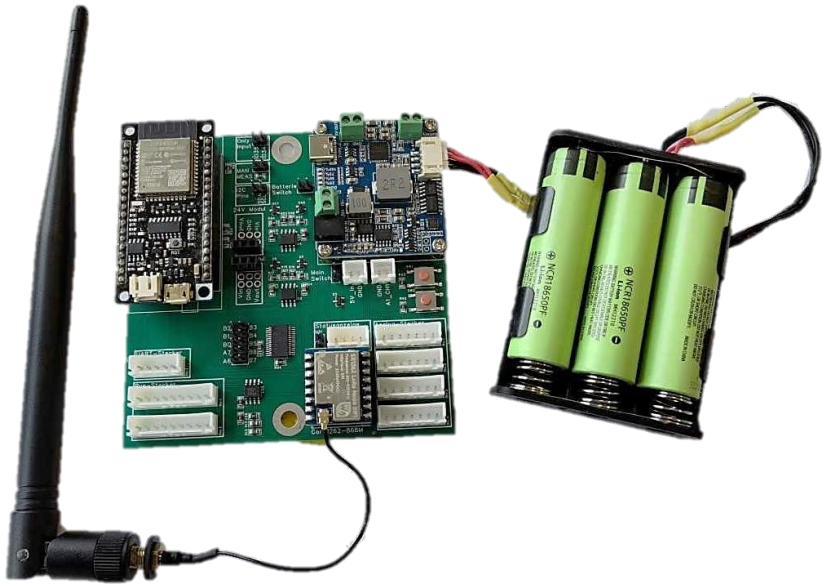
Microcontroller **15€**
Firebeetle ESP32

Communication hardware **20€**
SX1262 LoRaWAN-Board, rod antenna

Power management **40€**
Li-Ion batteries, 10W solar panel,
power management board

Housing **10€**

100€



[2]

[1]

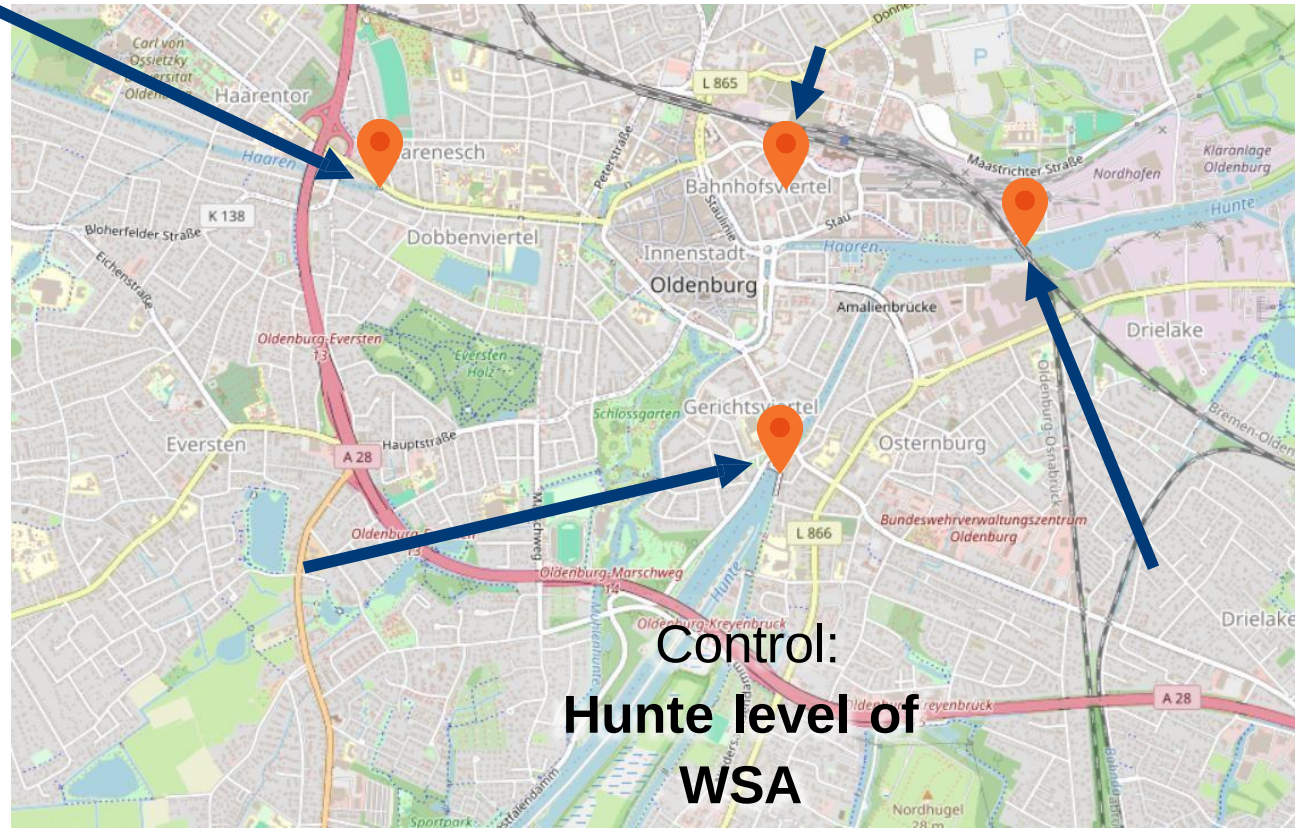
[1]https://cdn-reichelt.de/resize/600%2F-/web/xxl_ws/C700%2FPB500091.png
[2]https://www.offgridtec.com/thumbnail/2e/f4/ea/1750833700/3-01-001265_1920x1920.jpg

Locations of interest

Tributary:
Haaren

[2]

Sink hole:
Kulturetage



Control:
Hunte level of WSA

[3]

River:
Hunte

[1]

[1]https://www.oldenburg.de/fileadmin/_processed_/9/a/csm_Caecilienbruecke_2020_StOl_10_bd468a0f3a.jpg
[2]https://www.oldenburg.de/fileadmin/_processed_/d/0/csm_Kulturetage_c_Mittwollen_und_Gradetchliev_437c17f44c.jpg
[3]https://www.wsa-weser-jade-nordsee.wsv.de/SiteGlobals/Frontend/Webs/WNA-WSA/Images/logo.png?__blob=normal&v=2

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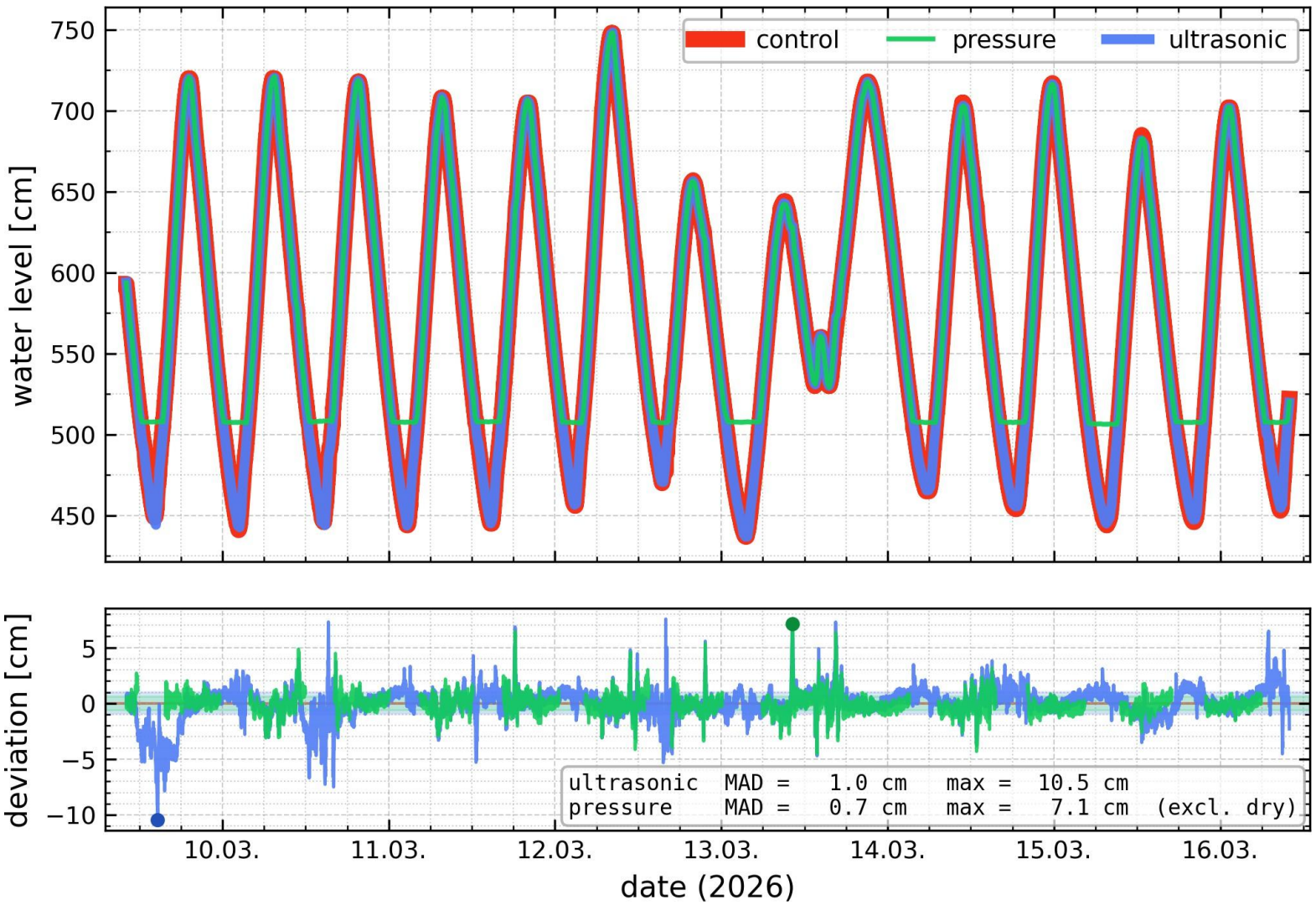
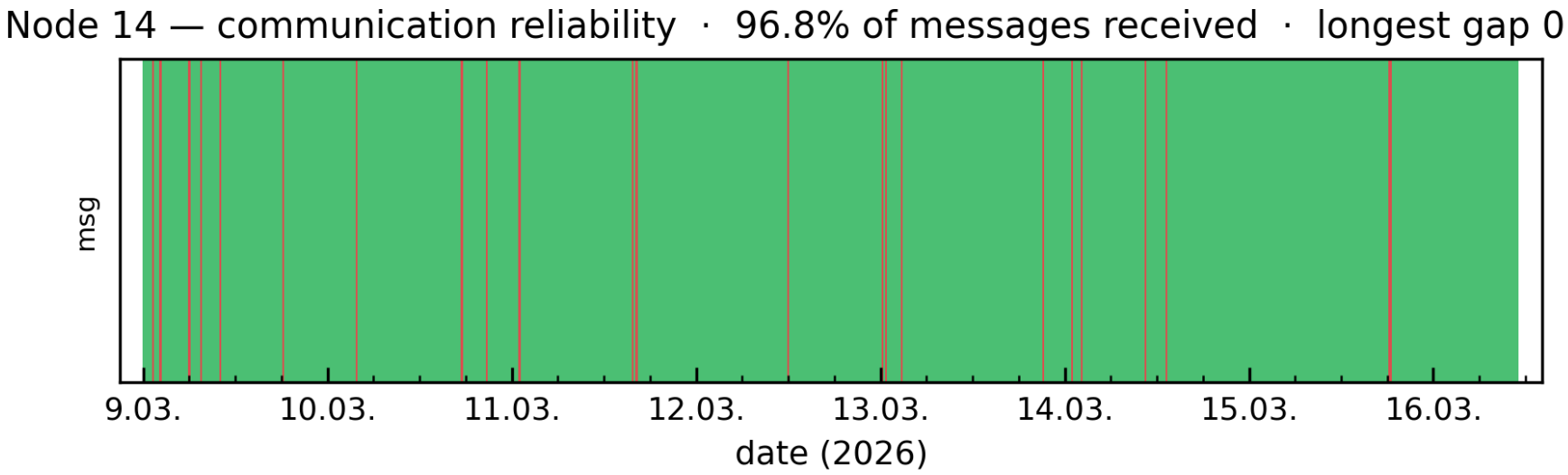
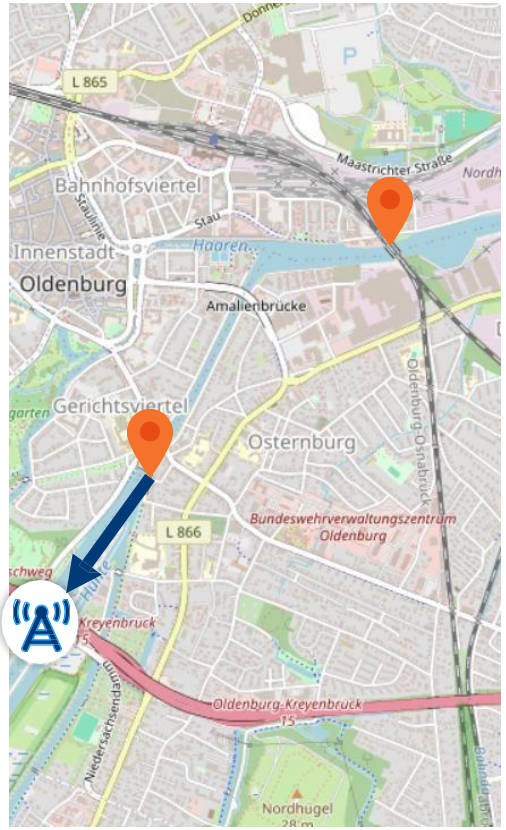
Evaluation: Data quality

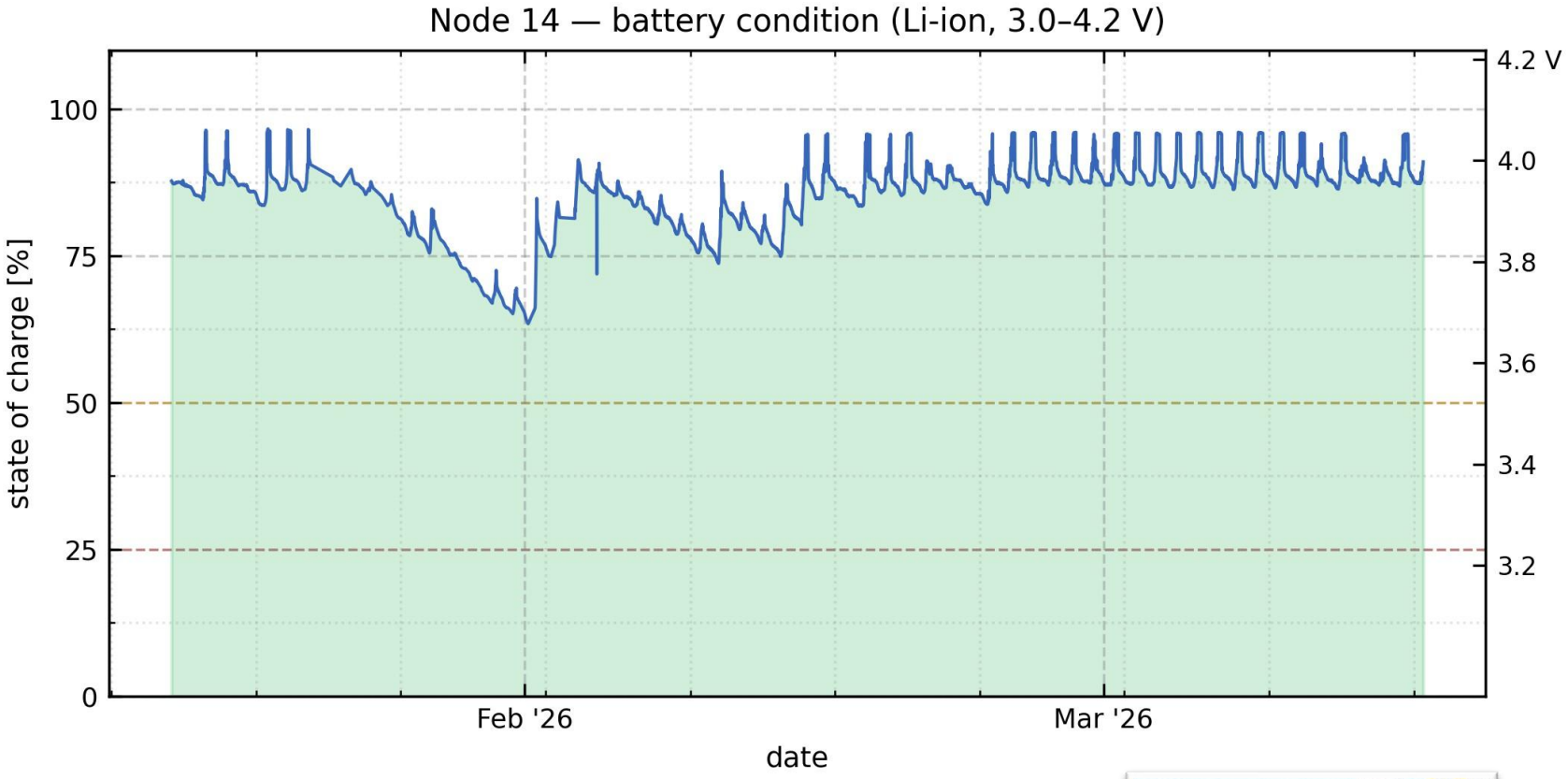


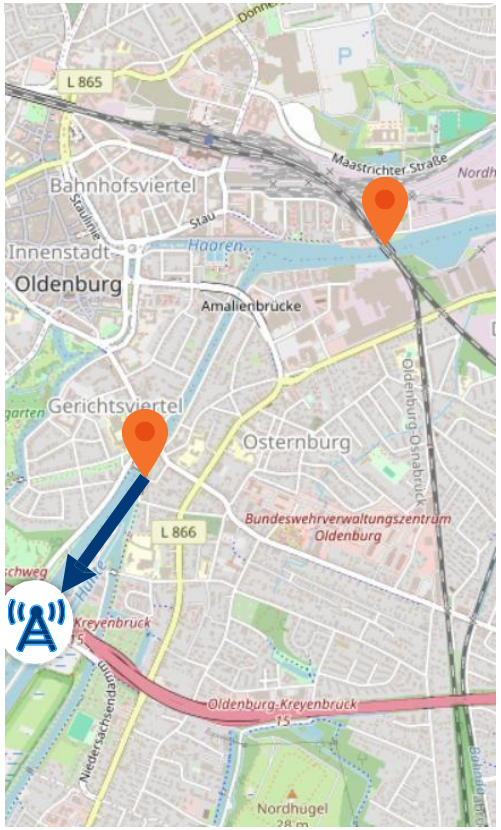
Evaluation: Communication quality

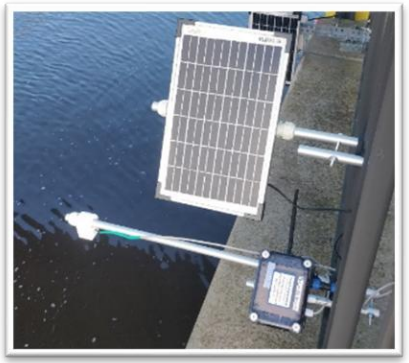




Evaluation: Communication quality and autonomy







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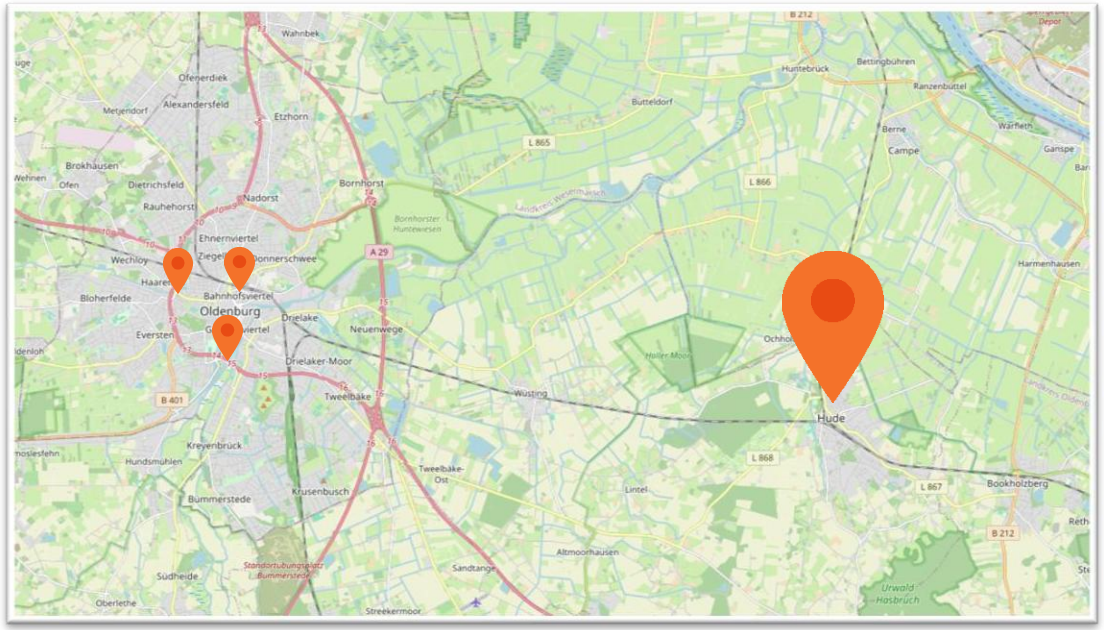
Evaluation: Cost

Base hardware	Sensors	Misc.	Total
100€	80€	20€	**200€**

- Hardware cost fraction of commercial gages (15.000€+ per node)
- Personell cost of building, deploying and maintaining nodes **not** included
- Attractive for citizen science and educational scenarios

Next steps

[1]



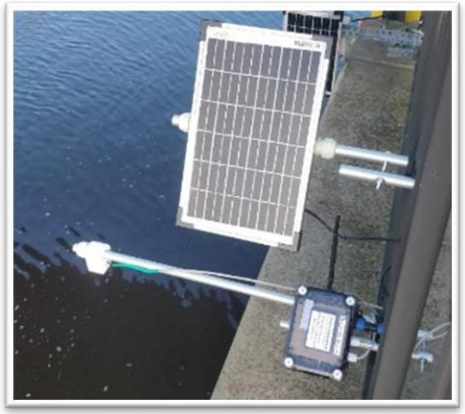
OIDD

Guerilla Sensing

[1] https://www.feuerwehr-hude.de/hude/feuerwehrhaus

Summary

[1]



Data Quality	Comparable to commercial solution
Communication Quality	97% successful transmissions
Autonomy	No downtime since 14.01.2026
Cost	~200€ per node

[1]https://www.oldenburg.de/fileadmin/_processed_/6/1/csm_DJI_20240101145635_0015_V_230ea5d50e.jpg