




S2 Standard

# EN 50491-12-2 Overview

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OpenADR++ User Conference 2024

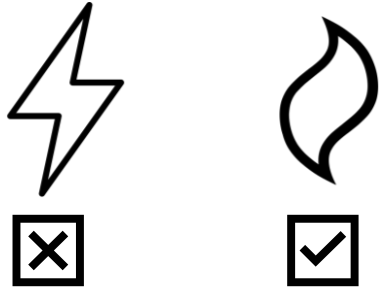
# Heat pump as an example

GO 



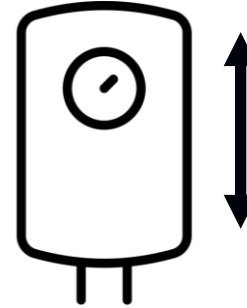
# How can a heat pump be flexible?

Switch Energy Source

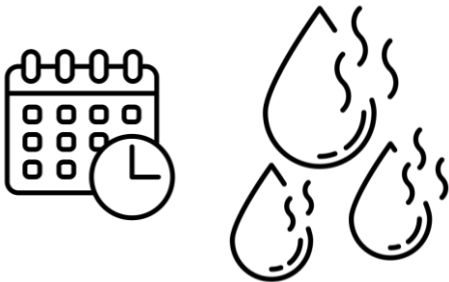


*Hybrid heat pump only*

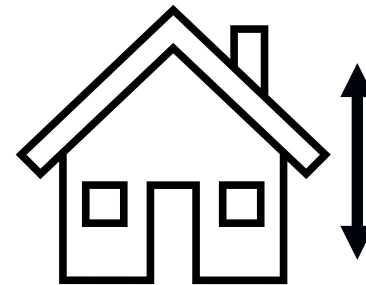
DHW Storage Tank



Anti-legionella Cycle



Thermal Mass



# S2 (EN 50491-12-2) Background



# Short history of S2

- 2011 - Mandate 490 by European Commission
- 2015 – Start of standardisation of current S2 version in CENELEC TC205/WG18
- 2022 – Official European S2 standard: EN 50491-12-2
- 2022 – Start of global S2 standardisation in IEC SC23K WG3 / TC13
- 2023 – Inclusion of S2 datamodel in SAREF4ENER

# Key takeaways of S2

Only manages energy flexibility

Future-proof interoperability

S2 does not interfere with the OEM

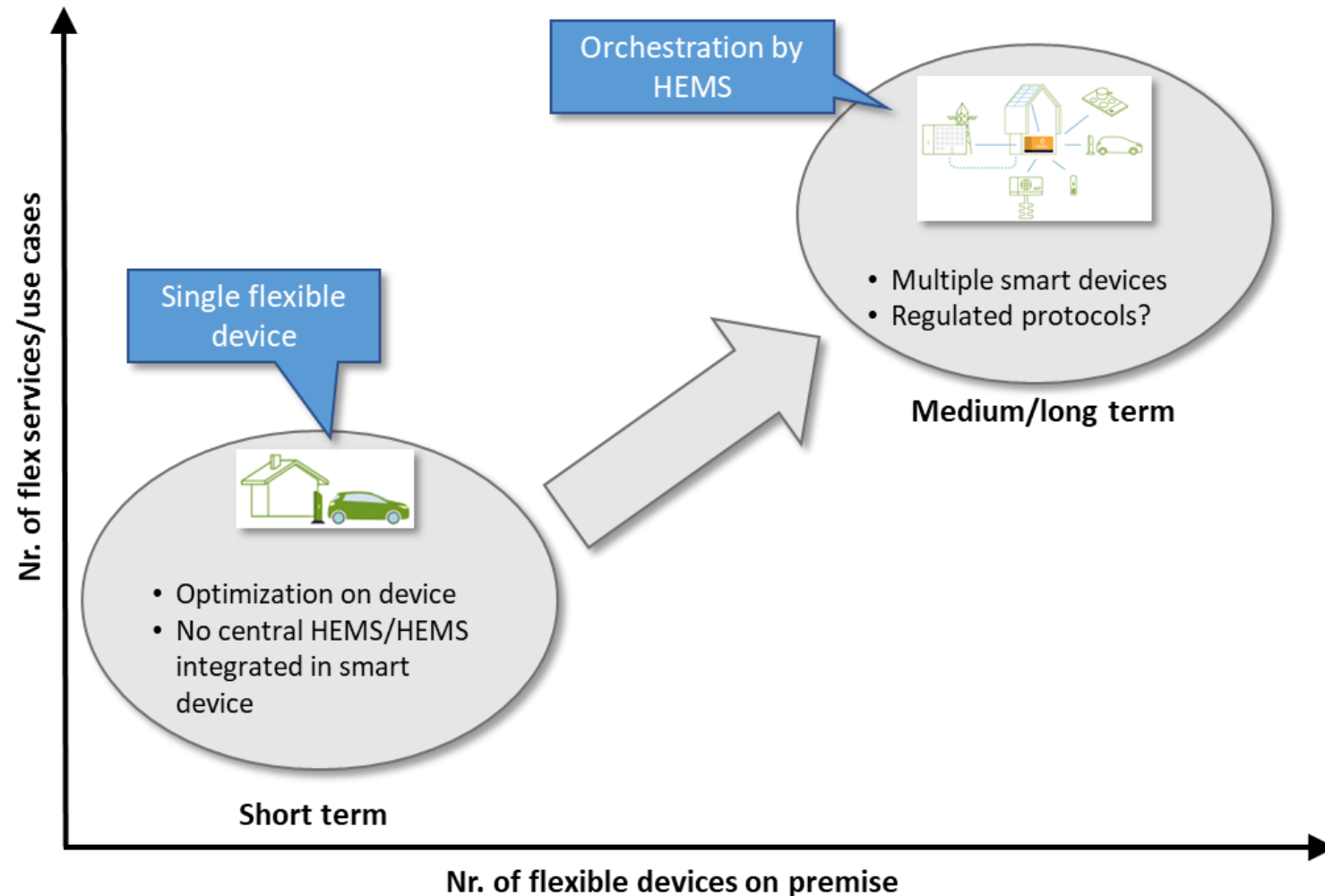
S2 is an add-on to existing protocols

Open market for EMS

# S2 services all stakeholder-groups:

- **DSO's and TSO's**
  - Congestion management and balancing
- **Energy Service Providers & Energy Communities**
  - E.g. optimize for dynamic tariffs or optimization within community
- **OEMs / manufacturers of Energy Smart Appliances**
  - Full control over how much flexibility is being exposed
- **EMS / HEMS / BEMS developers**
  - Freedom to develop new optimization strategies/algorithms for orchestration of Energy Smart Appliances

# Energy Management Timeline



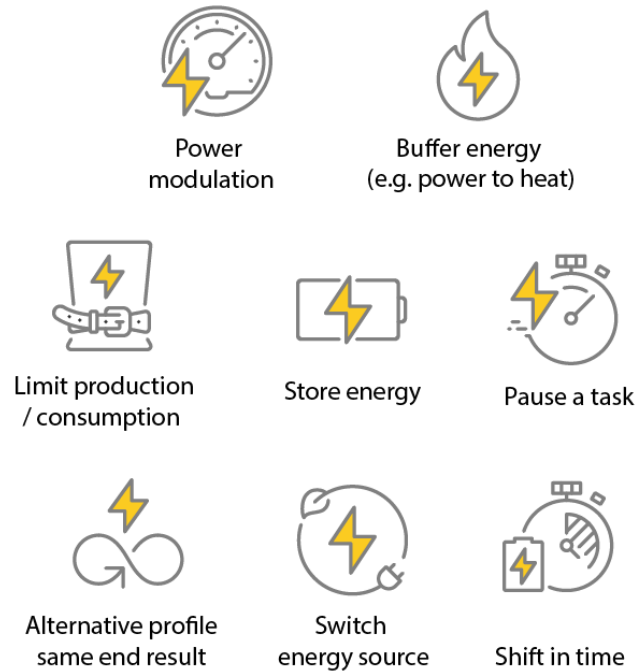
- USP for a smart device will be how much added value it can bring to a consumer out of the box
- A HEMS coordinating multiple smart devices will not be on most consumers mind yet
- However, smart devices can have a lifespan of up to 15 years or more and should be able to deal with both autonomous operation and central control by a HEMS
- If the HEMS scenario is not taken into account smart devices may even hinder the full flex potential of a premise

We should be able to deal with services that we can not envision yet

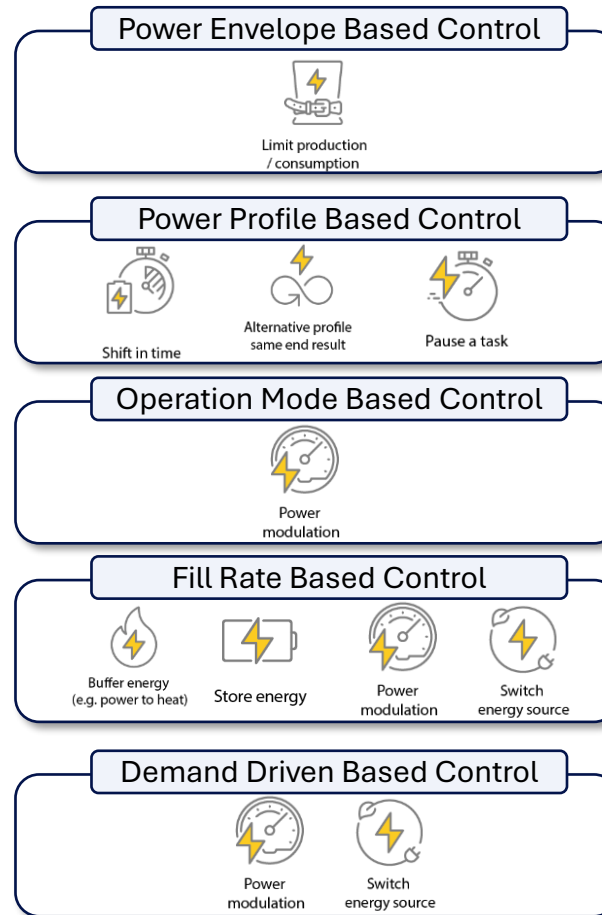


# Flex capability based approach of S2

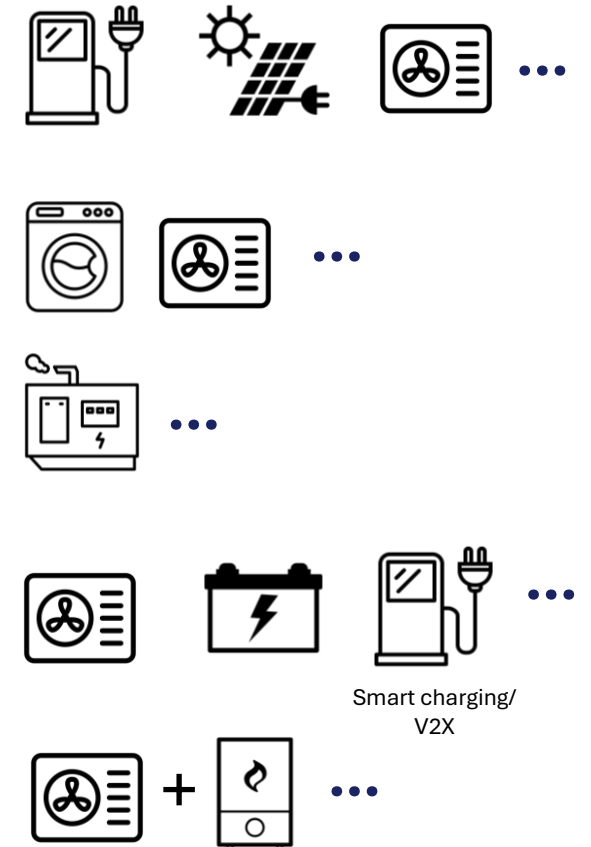
8 generic energy flexibility capabilities ...




... are combined into 5 control types ...



... to manage flexibility of energy smart appliances



# S2 architecture

WARNING	
	S2 CEM $\neq$ PAS 1878 CEM
	S2 RM $\approx$ PAS 1878 CEM

- Responsibility of OEM, OEM keeps control
- Communicates flexibility options from smart device
- Safeguards safety and performance constraints
- End user provides comfort requirements
- Translates device protocol into S2 and vice versa

Elaadnl

External Logic

External Protocol

CEM



EN50491-12-2

S2 Standard

Resource Manager

ithodaalderop  
Climate for life

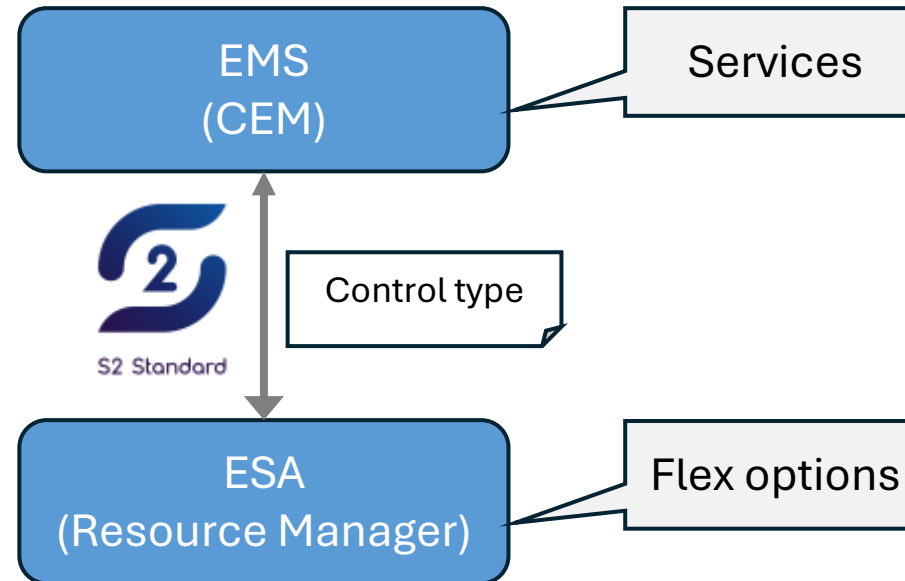
Device Protocol

ESA



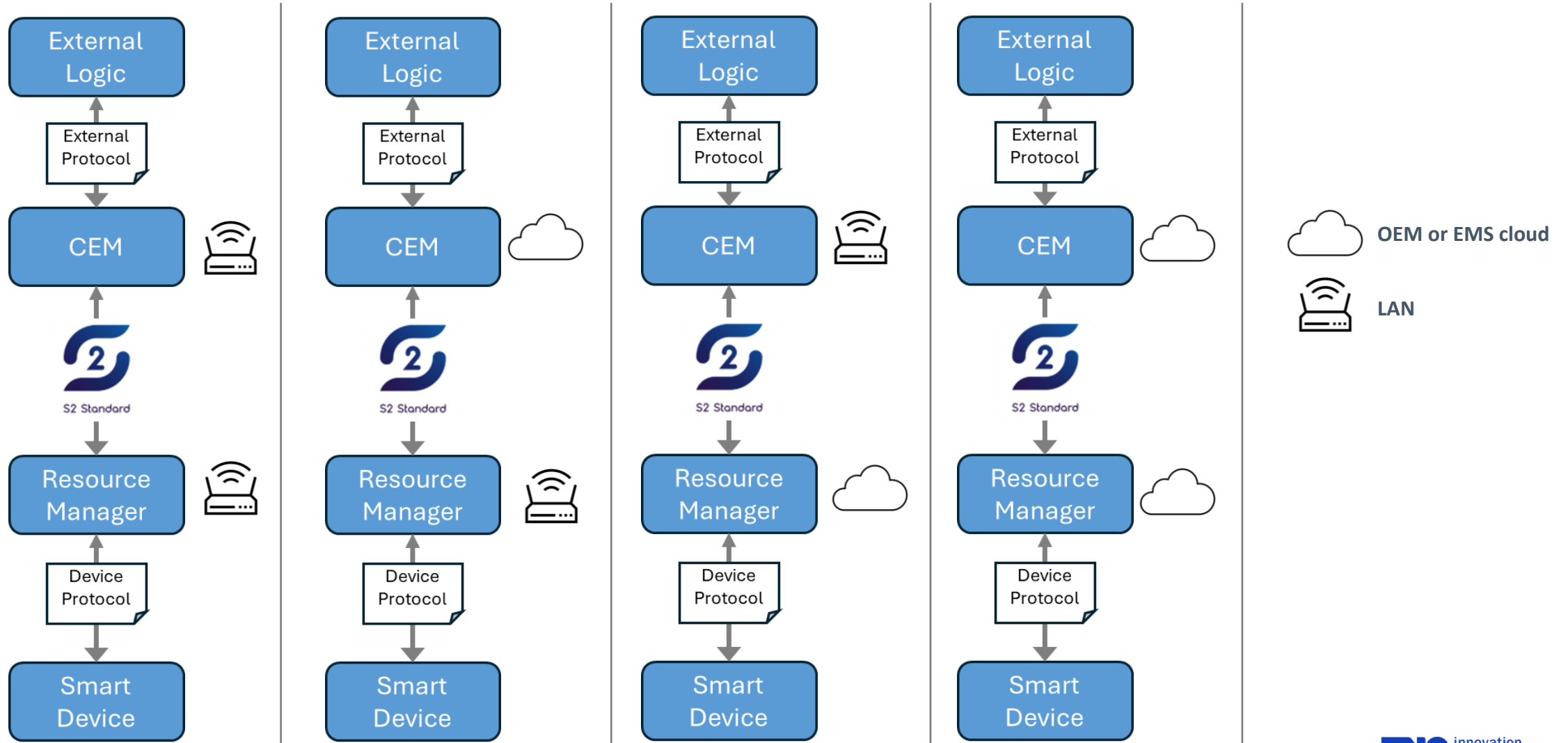
- Responsibility of HEMS/aggregator/supplier/...
- Implementation of flexibility use cases
  - tariffs, self-optimization, congestion
- End user chooses optimization strategy

# Adding new use cases/services



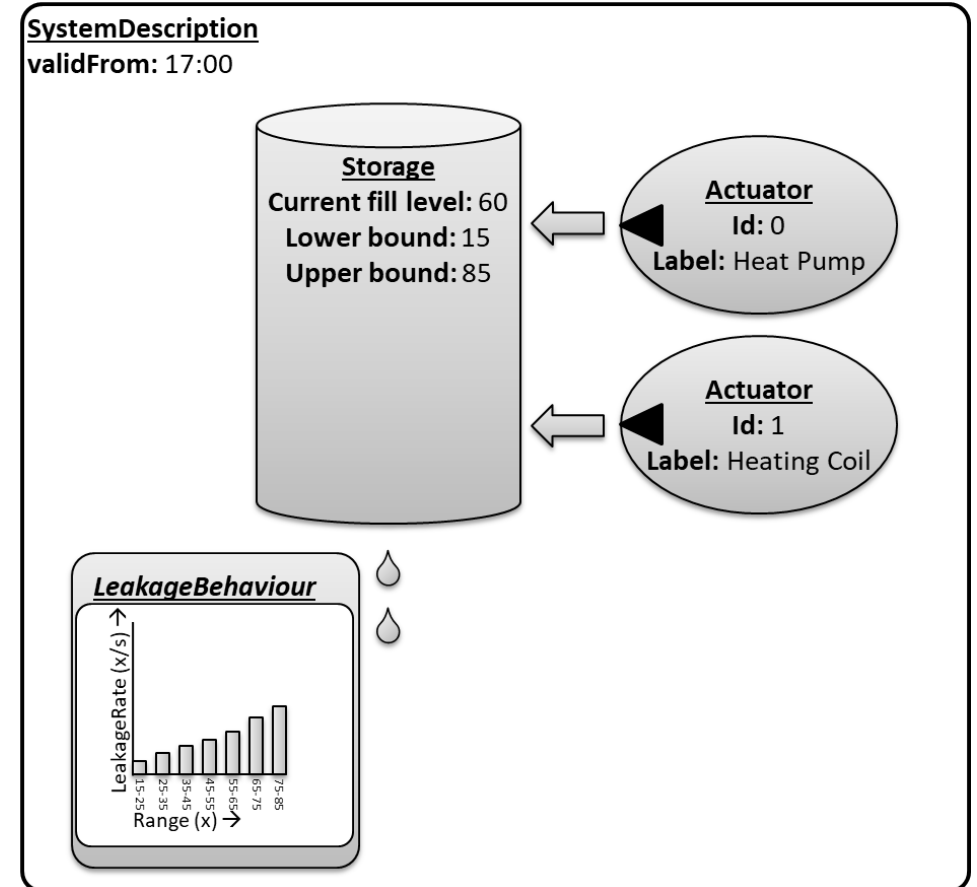
- Use cases/services are only implemented on the HEMS → HEMS providers can freely implement new use cases/services
- Interoperability is guaranteed when the HEMS implements all 5 control types and the ESA at least 1
- No ESA updates required for a new use case/service

# S2 deployment options for RM and CEM



# Fill Rate Based Control (1/3)

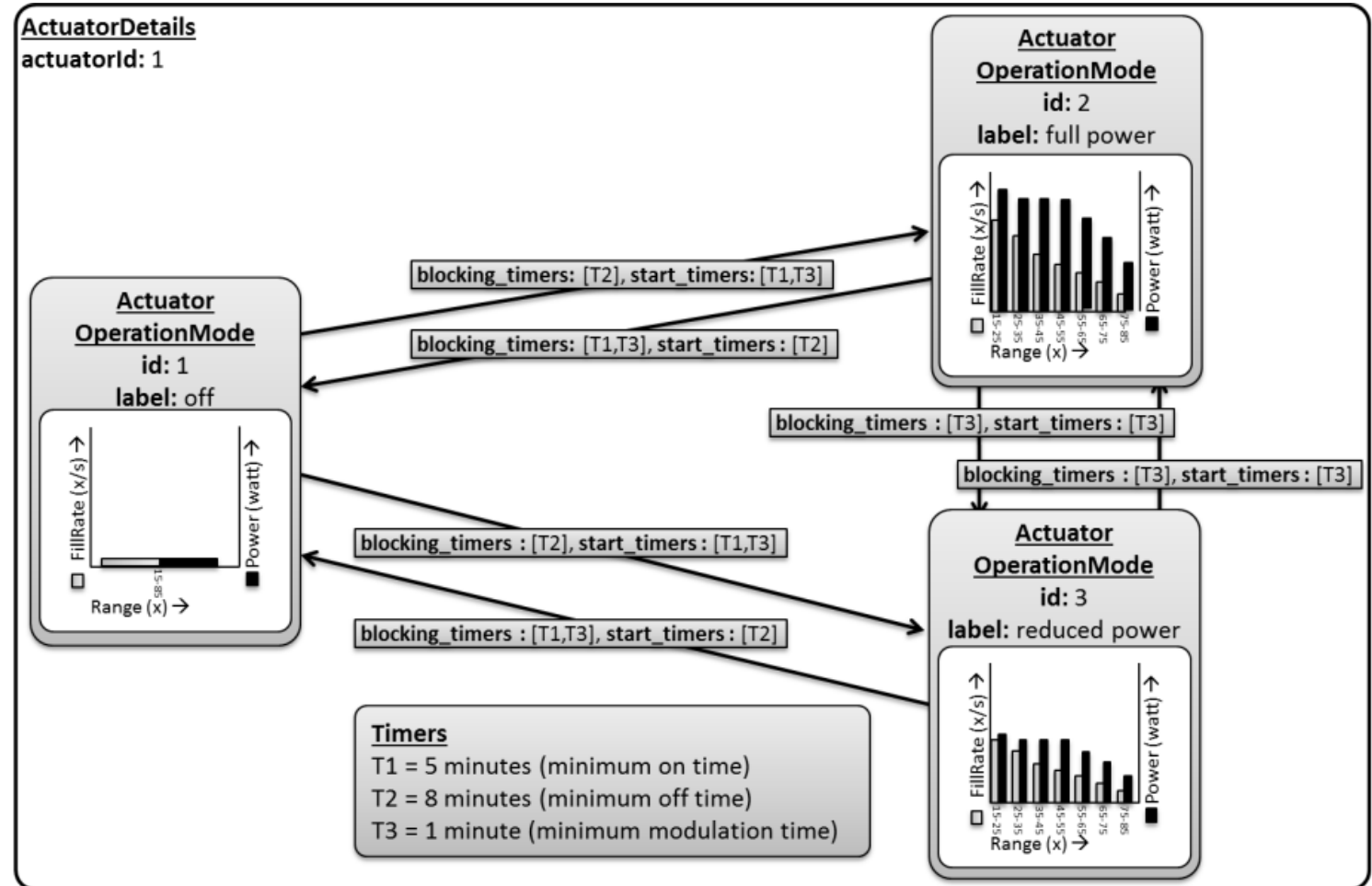
- Applicable for HVAC, Smart EV Charging, Batteries, etc.
- Modelled around the SoC of a buffer/storage
  - The quantity that is being managed is not relevant
    - Could be temperature, kWh, etc.
- Actuators convert electricity into additional SoC
  - Or vice versa in the case of storage



$$\text{net fill rate} = \text{fill rate actuator0} + \text{fill rate actuator1} - \text{leakage rate}$$

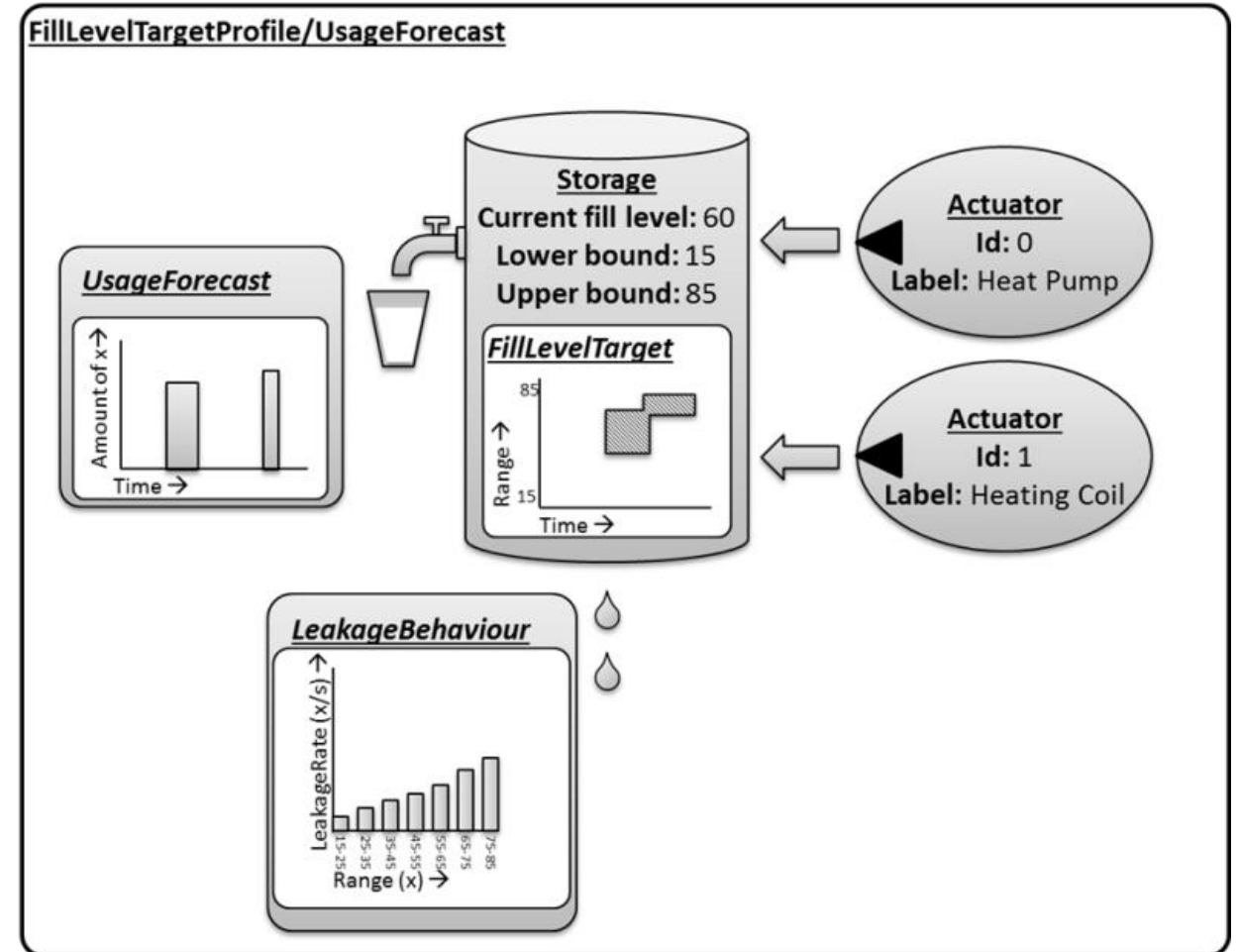
# Fill Rate Based Control (2/3)

- The behaviour of an actuator is modelled as a state machine
- States are referred to as Operation Modes
- An Operation Mode features a fill rate function that shows the ratio between power consumption and the fill rate of the buffer/storage
- Transitions between Operation Modes can have constraints associated with them in the form of timers



# Fill Rate Based Control (3/3)

- Additional constraints can be defined with regard to
  - Fill level / SoC target
  - Extraction from storage/buffer



$$\text{net fill rate} = \text{fill rate actuator0} + \text{fill rate actuator1} - \text{leakage rate} - \text{usage forecast}$$

# Next steps for unlocking heat pumps in S2

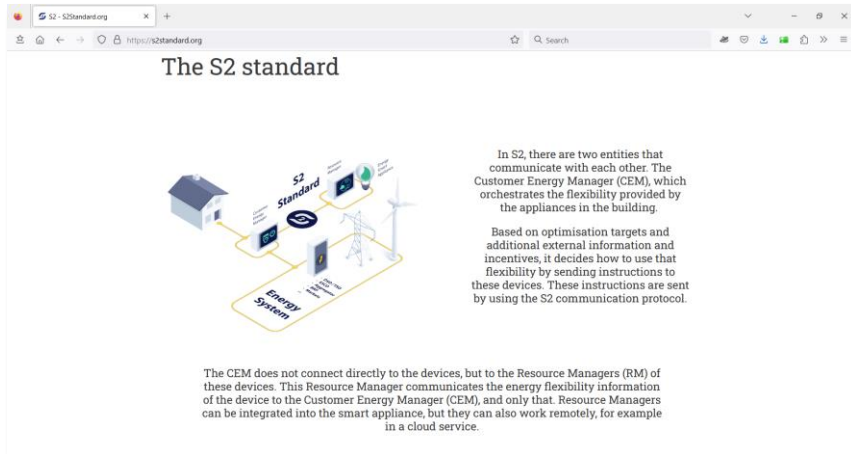
- KIFLIN project: operationalize S2 communication further with Itho Daalderop and Seita



- Open Heat proposal: expand to multiple heat pump manufacturers and EMS providers



# Want to know more?



The S2 standard

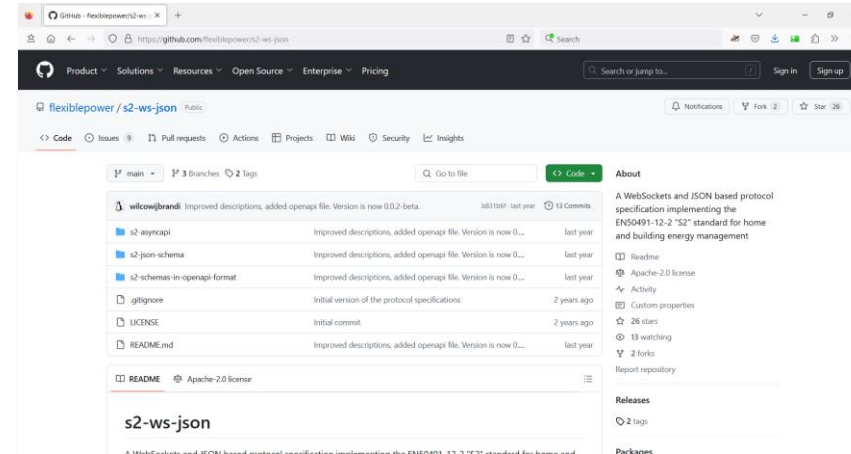
In S2, there are two entities that communicate with each other. The Customer Energy Manager (CEM), which orchestrates the flexibility provided by the appliances in the building.

Based on optimisation targets and additional external information and incentives, it decides how to use that flexibility by sending instructions to these devices. These instructions are sent by using the S2 communication protocol.

The CEM does not connect directly to the devices, but to the Resource Managers (RM) of these devices. This Resource Manager communicates the energy flexibility information of the device to the Customer Energy Manager (CEM), and only that. Resource Managers can be integrated into the smart appliance, but they can also work remotely, for example in a cloud service.

The screenshot shows a diagram of a house connected to an S2 Standard and an Energy System. Text explains the communication between the Customer Energy Manager (CEM) and Resource Managers (RM) to orchestrate flexibility.

<https://s2standard.org/>



flexiblepower / s2-ws-json

Code Issues Pull requests Actions Projects Wiki Security Insights

main 3 Branches 2 tags

imilovibrandi Improved descriptions, added openapi file. Version is now 0.0.2-beta. 383188f last year 13 Commits

s2-asyncapi Improved descriptions, added openapi file. Version is now 0... last year

s2-json-schema Improved descriptions, added openapi file. Version is now 0... last year

s2-schemas-in-openapi-format Improved descriptions, added openapi file. Version is now 0... last year

gitignore Initial version of the protocol specifications 2 years ago

LICENSE Initial commit 2 years ago

README Improved descriptions, added openapi file. Version is now 0... last year

README Apache-2.0 license

s2-ws-json

A WebSockets and JSON based protocol specification implementing the EN50491-12-2 "S2" standard for home and building energy management

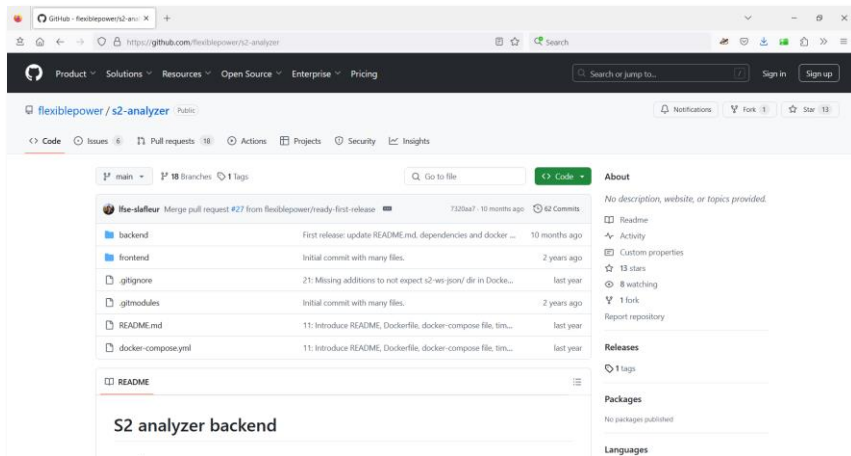
Readme Apache-2.0 license Activity Custom properties 26 stars 13 watching 2 forks Report repository

Releases 2 tags

Packages

The screenshot shows the GitHub repository page for 'flexiblepower/s2-ws-json', listing various files and their commit history.

<https://github.com/flexiblepower/s2-ws-json>



flexiblepower / s2-analyzer

Code Issues Pull requests Actions Projects Security Insights

main 18 Branches 1 tag

rise-staffeur Merge pull request #27 from flexiblepower/ready-first-release 7329a7 10 months ago 42 Commits

backend First release: update README.md, dependencies and docker ... 10 months ago

frontend Initial commit with many files. 2 years ago

gitignore 21: Missing additions to not expect s2-ws-json/ dir in Docke... last year

gitmodules Initial commit with many files. 2 years ago

README.md 11: Introduce README, Dockerfile, docker-compose file, tim... last year

docker-compose.yml 11: Introduce README, Dockerfile, docker-compose file, tim... last year

README

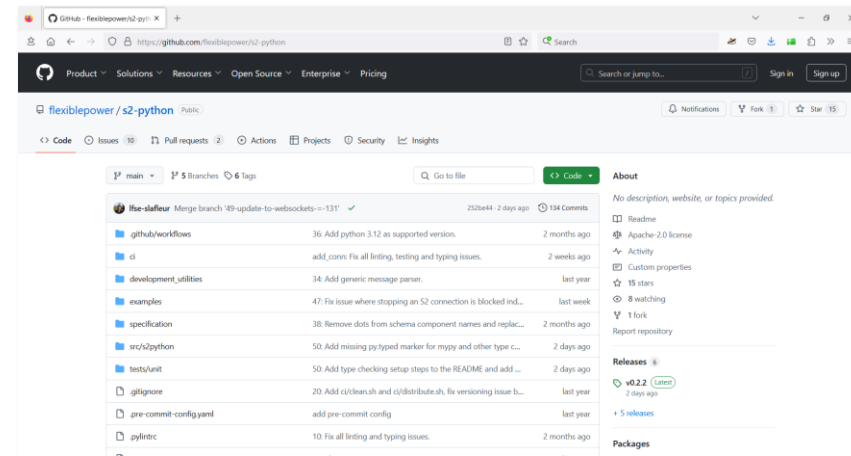
S2 analyzer backend

No packages published

Languages

The screenshot shows the GitHub repository page for 'flexiblepower/s2-analyzer', listing files and a recent pull request.

<https://github.com/flexiblepower/s2-analyzer>



flexiblepower / s2-python

Code Issues Pull requests Actions Projects Security Insights

main 5 Branches 6 tags

rise-staffeur Merge branch '49-update-to-websockets--131' 252b44 2 days ago 134 Commits

github/workflows 36: Add python 3.12 as supported version. 2 months ago

ci add\_comm: Fix all linting, testing and typing issues. 2 weeks ago

development\_utilities 34: Add generic message parser. last year

examples 47: Fix issue where stopping an S2 connection is blocked ind... last week

specification 38: Remove dots from schema component names and replac... 2 months ago

src/s2python 50: Add missing py-typed marker for mypy and other type c... 2 days ago

tests/unit 50: Add type checking setup steps to the README and add ... 2 days ago

gitignore 20: Add ci/clean.sh and ci/distribute.sh, fix versioning issue b... last year

pre-commit-config.yaml add pre-commit config last year

pylintrc 10: Fix all linting and typing issues. 2 months ago

No description, website, or topics provided.

Readme Apache-2.0 license Activity Custom properties 15 stars 8 watching 1 fork Report repository

Releases v0.2.1 (latest) 2 days ago + 5 releases

Packages

The screenshot shows the GitHub repository page for 'flexiblepower/s2-python', listing files and a recent merge.

<https://github.com/flexiblepower/s2-python>