S2 Standard

EN 50491-12-2 Overview

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OpenADR++ User Conference 2024

Heat pump as an example

itho daalderop
Climate for life

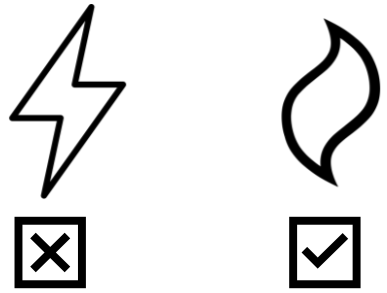
Elaad nl

Technolution
Spark

TNO

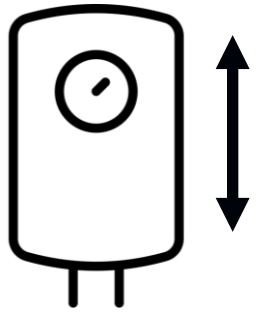
How can a heat pump be flexible?

Switch Energy Source

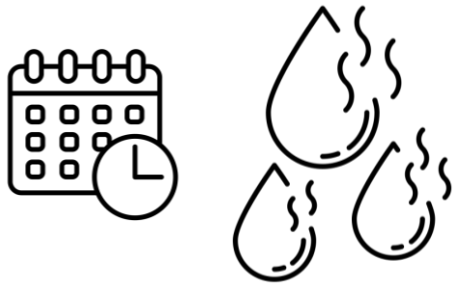


Hybrid heat pump only

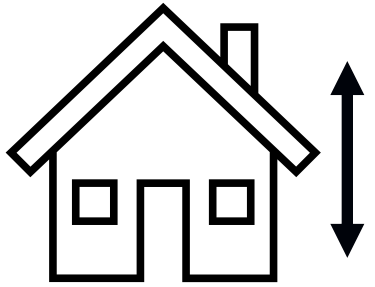
DHW Storage Tank



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

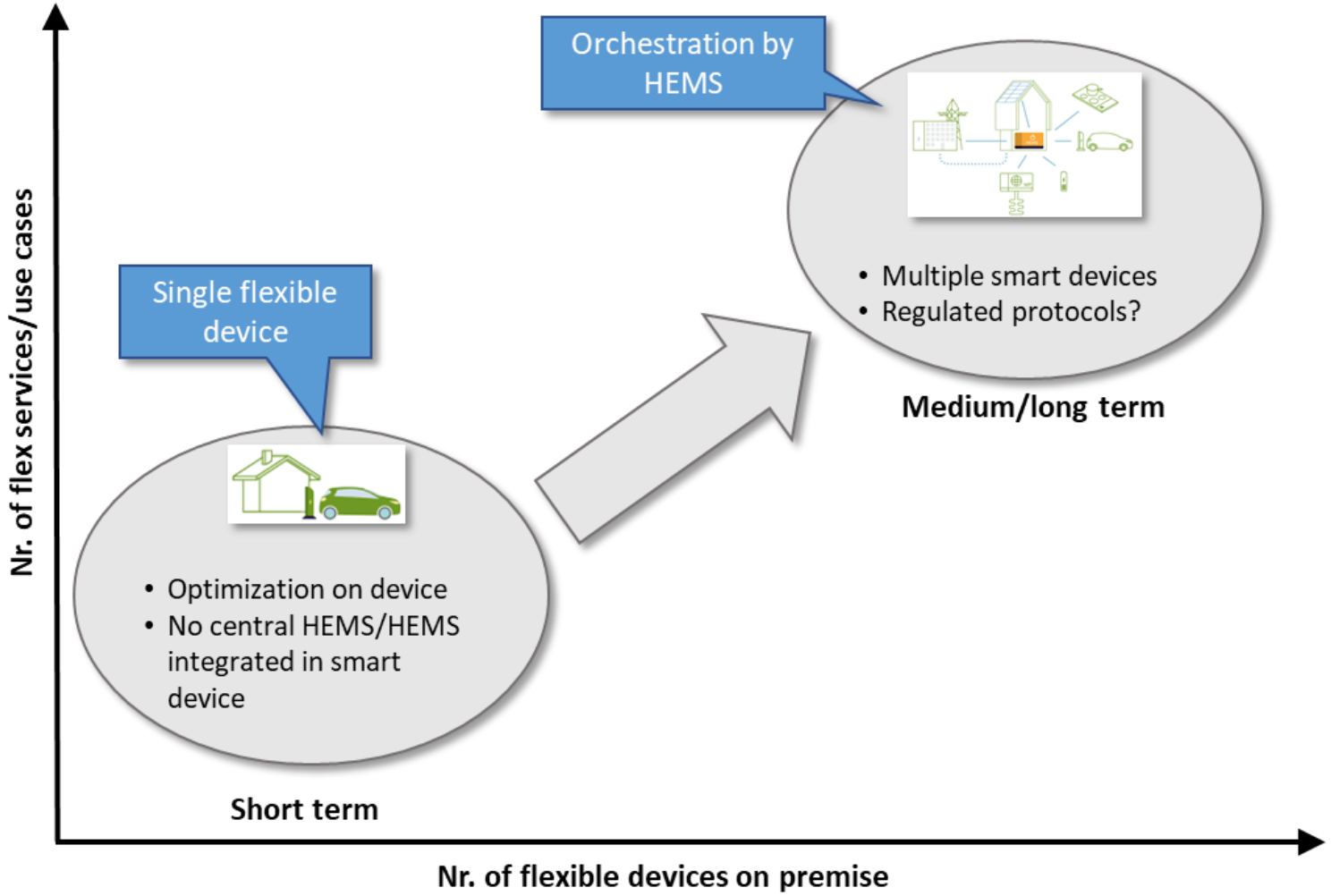
Key takeaways of S2

- 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

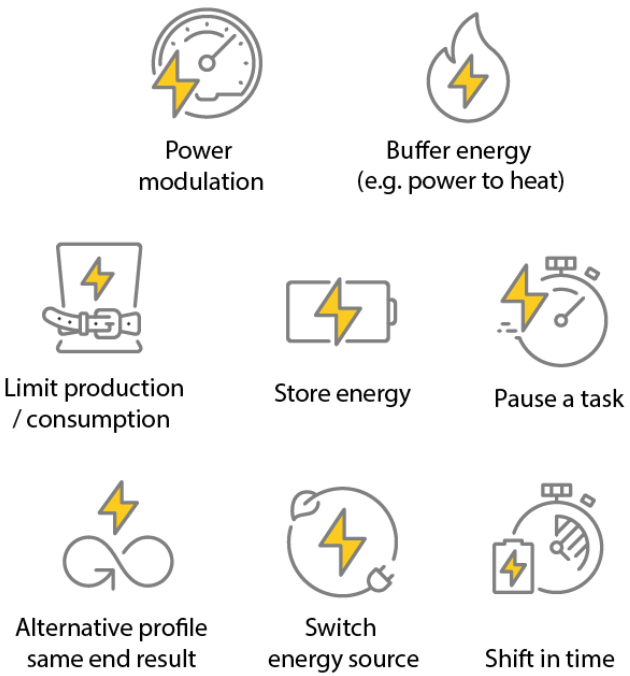


- USP for a smart device will be how much added value it can bring to a consumer out of the box
- A HEMS coordinating multiple smart devices will not be on most consumers mind yet
- However, smart devices can have a lifespan of up to 15 years or more and should be able to deal with both autonomous operation 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

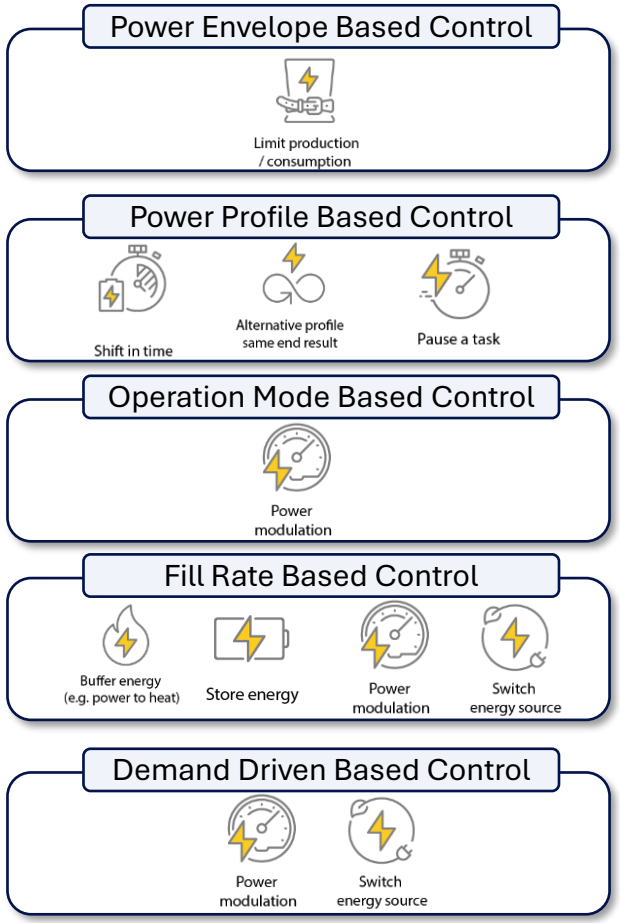
We should be able to deal with services that we can not envision yet

Flex capability based approach of S2

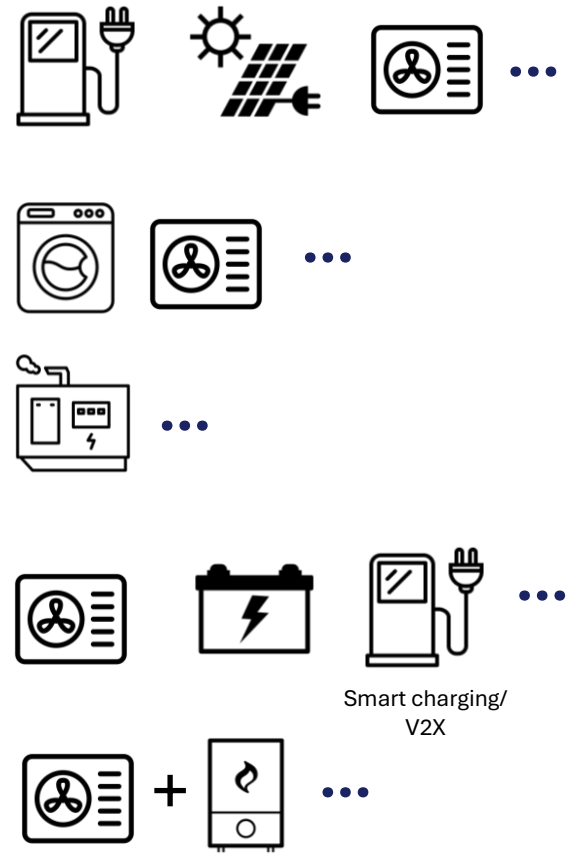
8 generic energy flexibility capabilities ...



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



... to manage flexibility of energy smart appliances



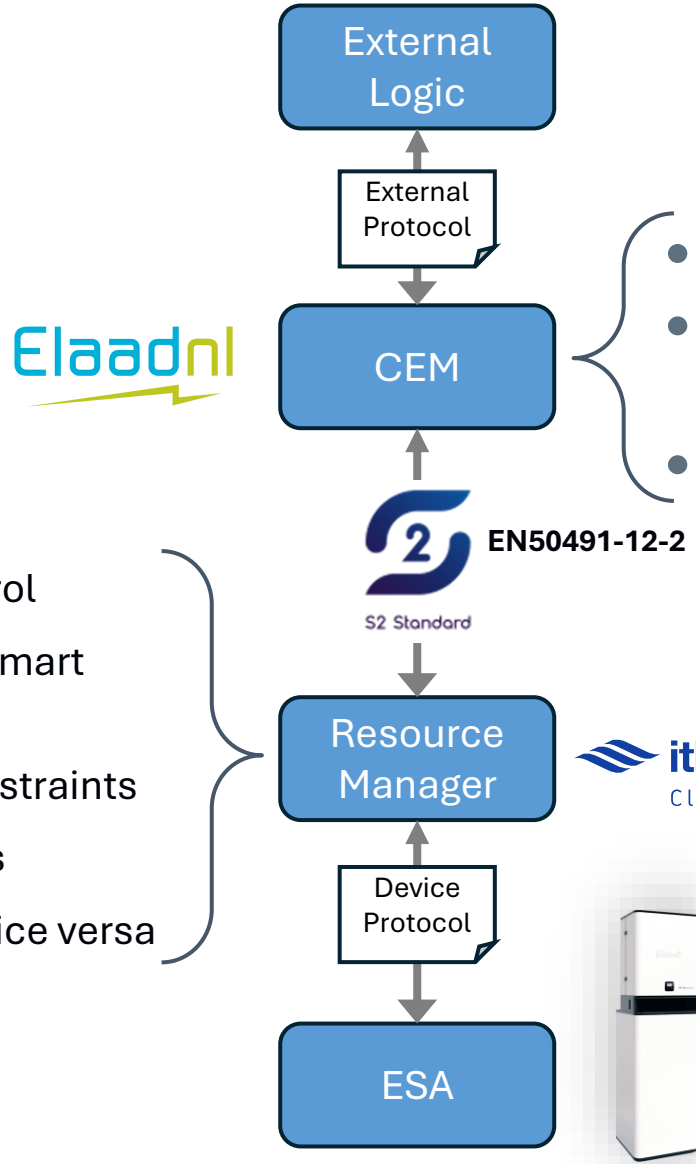
TNO innovation for life

S2 architecture

WARNING

S2 CEM ≠ PAS 1878 CEM

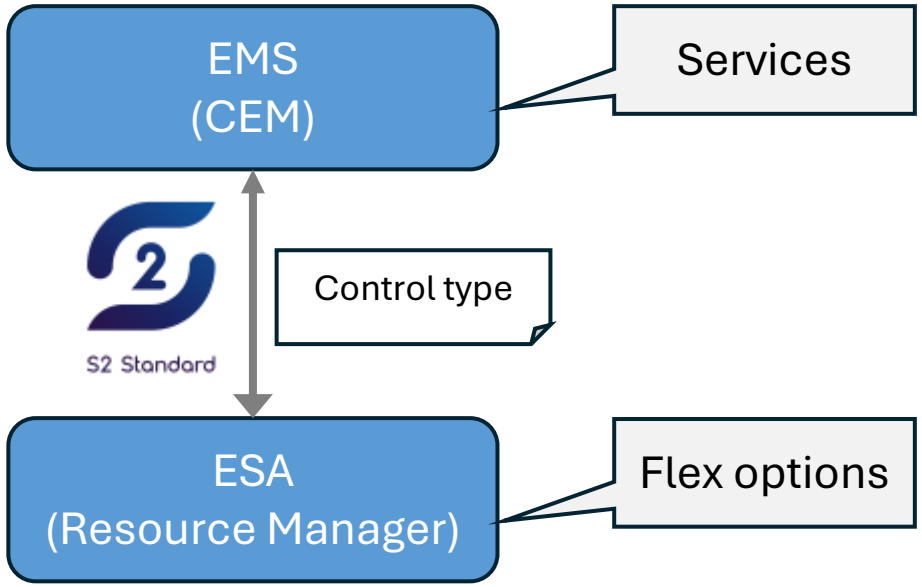
S2 RM ≈ PAS 1878 CEM



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

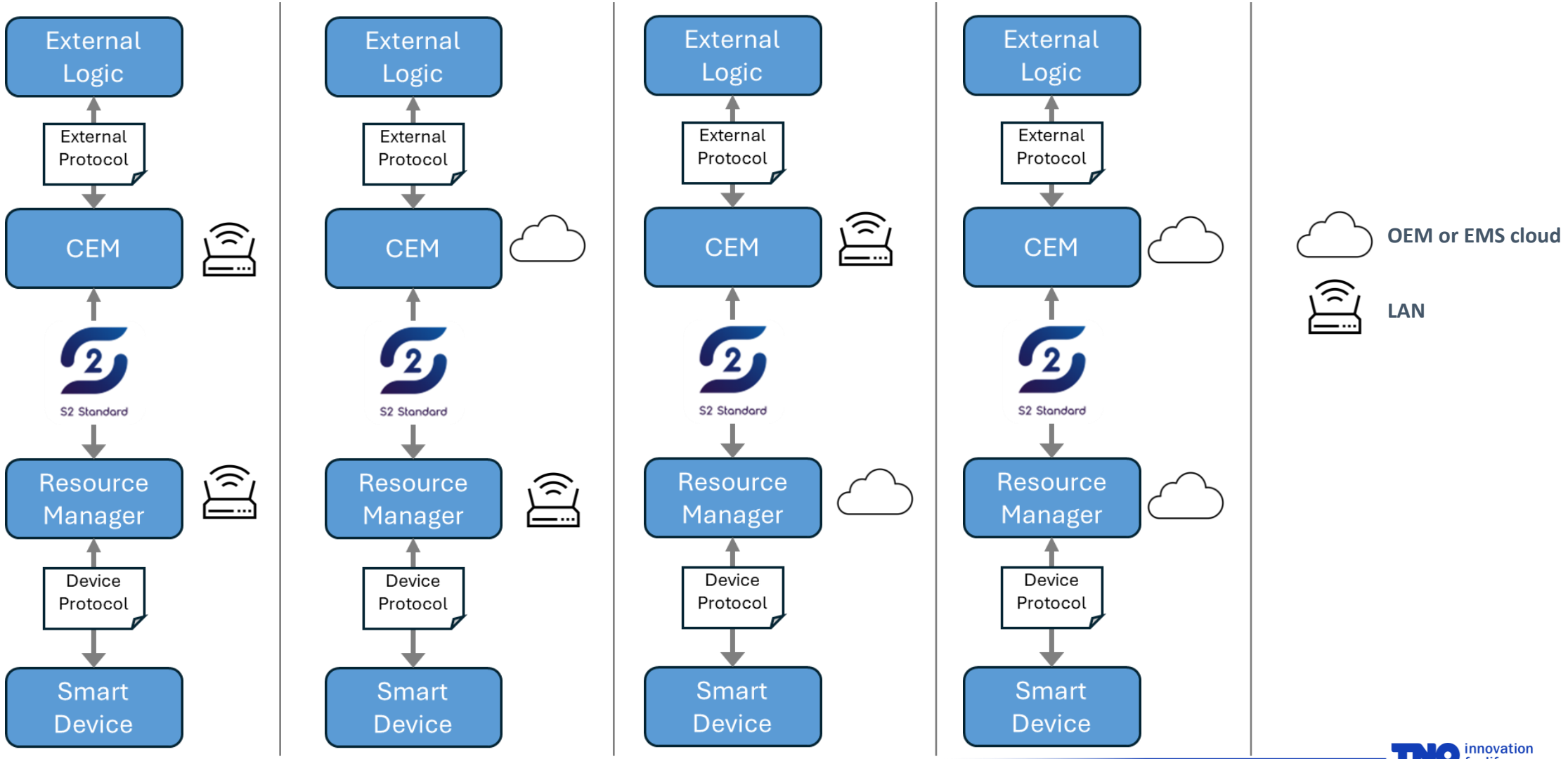
- Responsibility of OEM, OEM keeps control
- Communicates flexibility options from smart device
- Safeguards safety and performance constraints
- End user provides comfort requirements
- Translates device protocol into S2 and vice versa

Adding new use cases/services



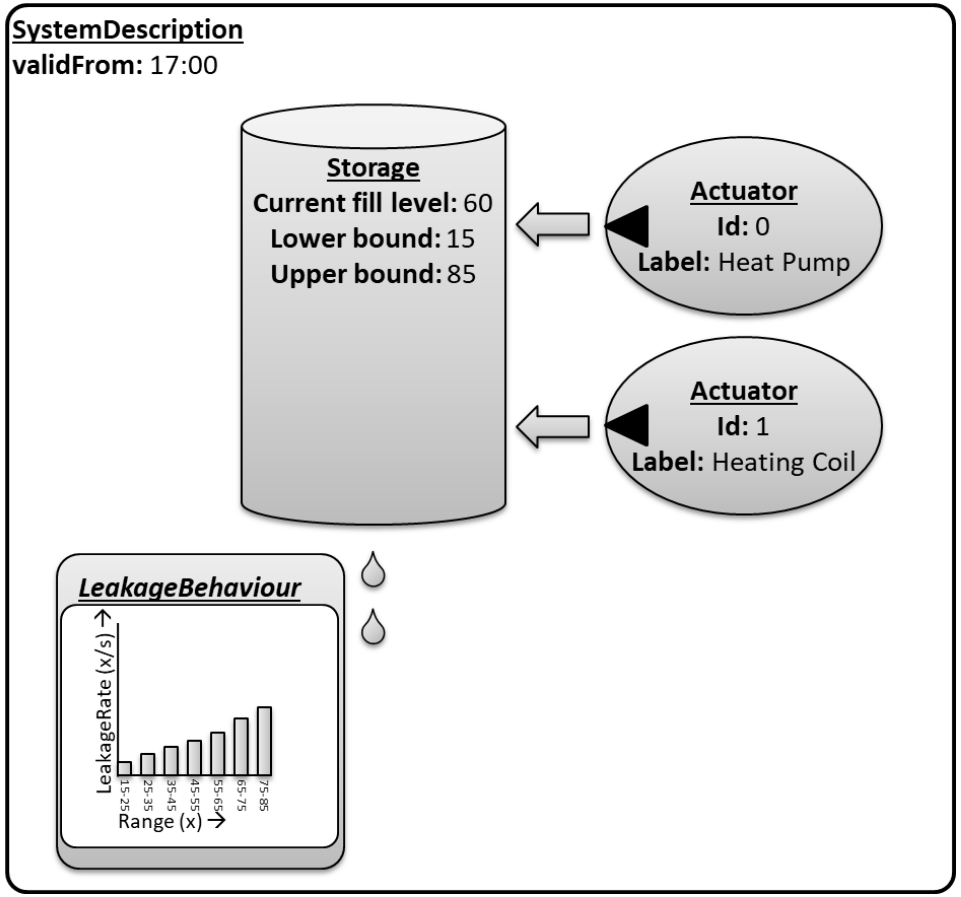
- Use cases/services are only implemented on the HEMS → HEMS providers can freely implement new use cases/services
- Interoperability is guaranteed when the HEMS implements all 5 control types and the ESA at least 1
- No ESA updates required for a new use case/service

S2 deployment options for RM and CEM



Fill Rate Based Control (1/3)

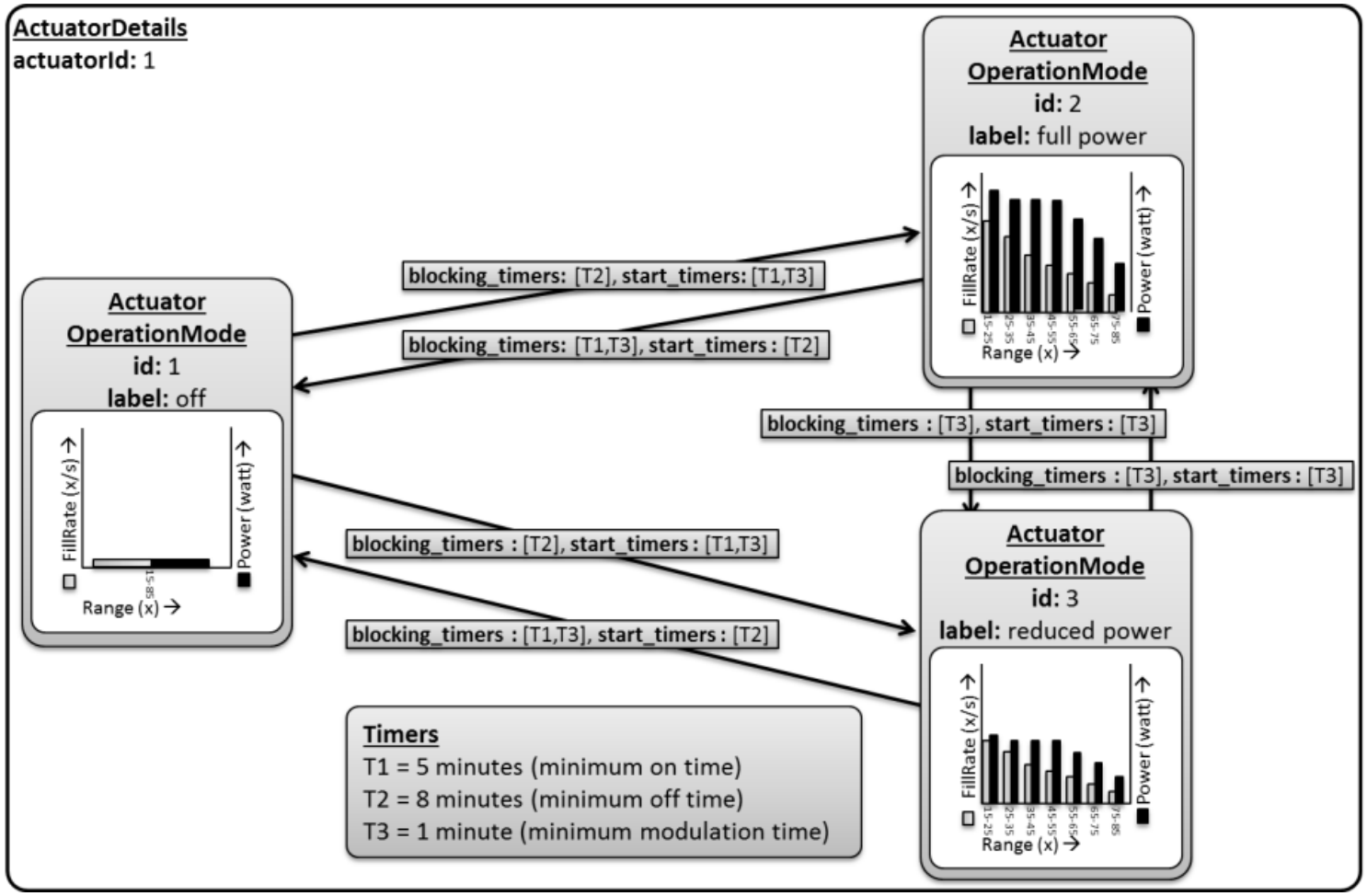
- Applicable for HVAC, Smart EV Charging, Batteries, etc.
- Modelled around the SoC of a buffer/storage
  - The quantity that is being managed is not relevant
    - Could be temperature, kWh, etc.
- Actuators convert electricity into additional SoC
  - Or vice versa in the case of storage



net fill rate = fill rate actuator0 + fill rate actuator1 - leakage rate

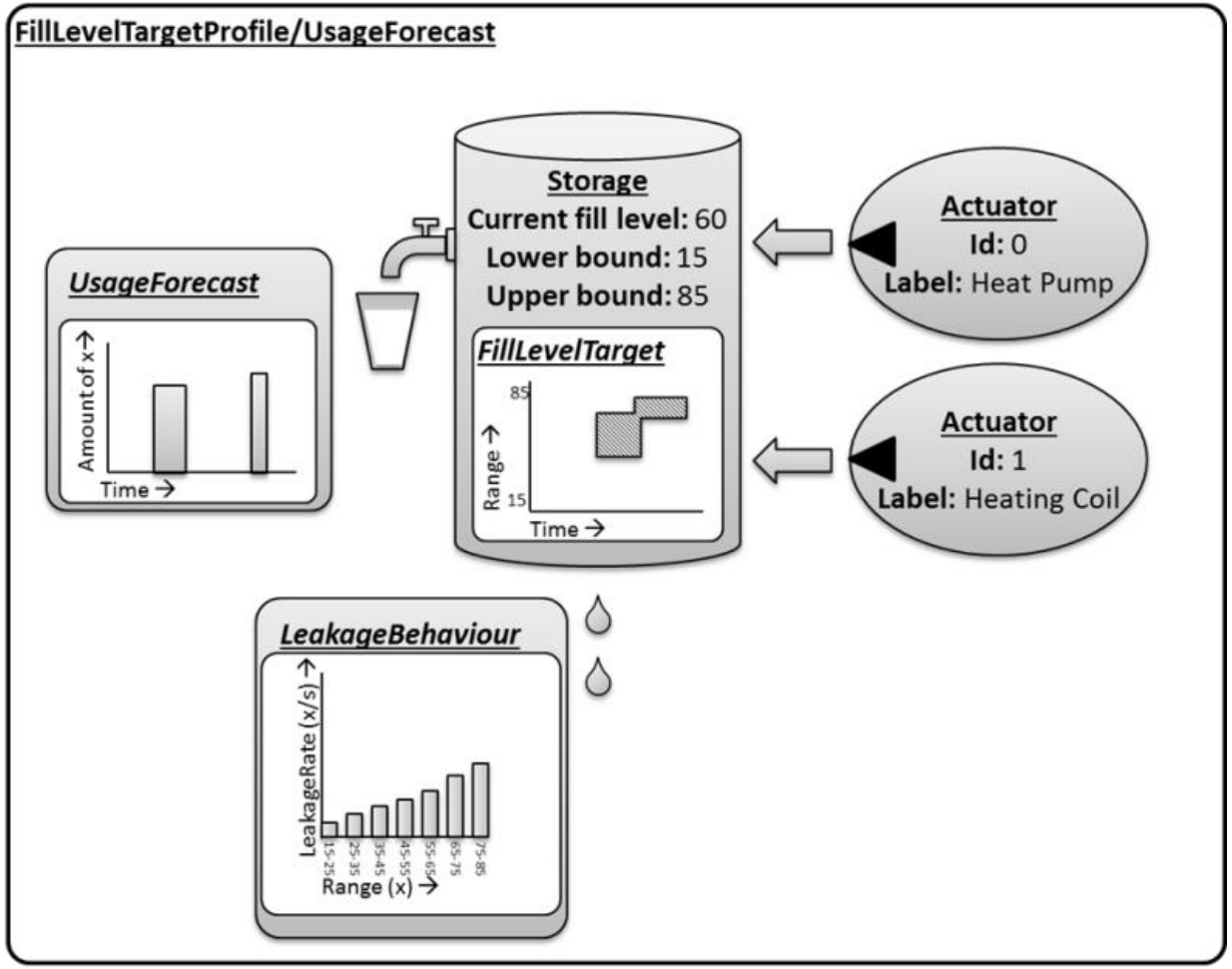
Fill Rate Based Control (2/3)

- 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



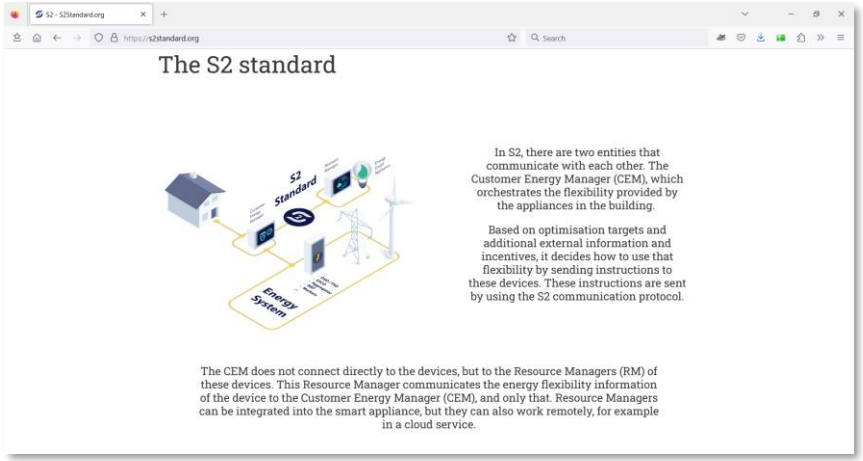
net fill rate = fill rate actuator0 + fill rate actuator1 - leakage rate - usage forecast

Next steps for unlocking heat pumps in S2

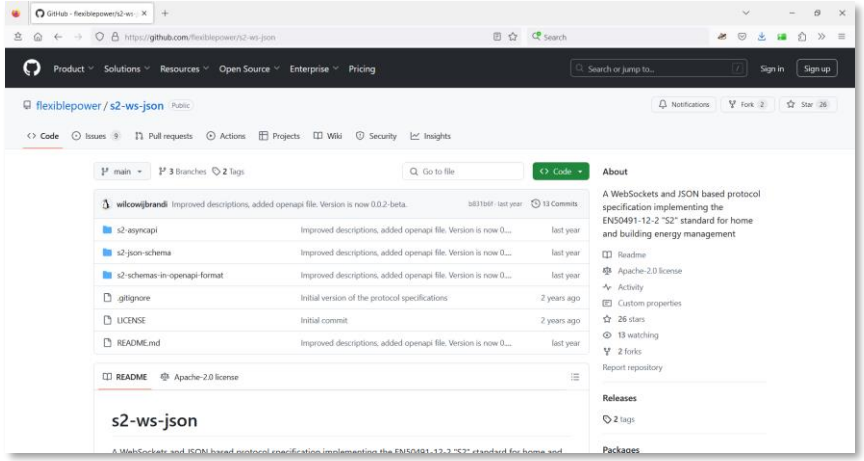
- KIFLIN project: operationalize S2 communication further with Itho Daalderop and Seita

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

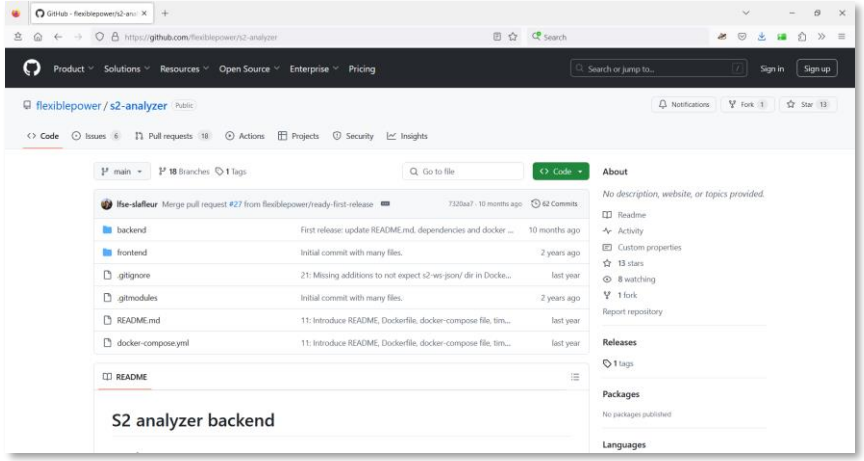
Want to know more?



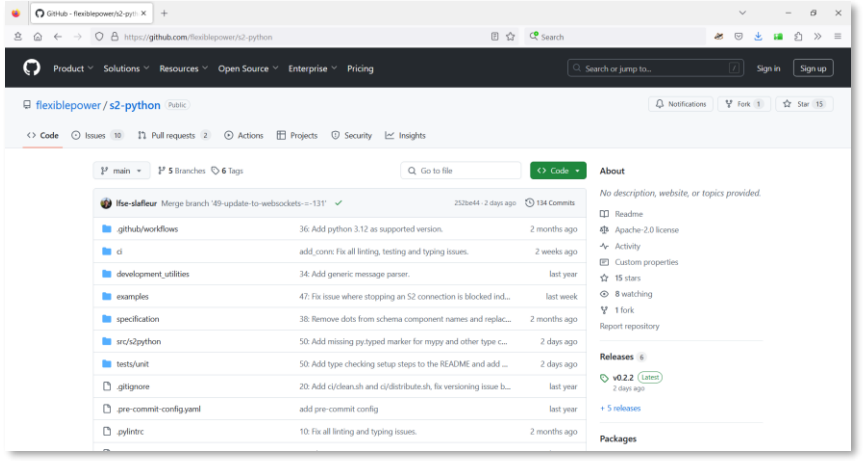
https://s2standard.org/



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



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



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