Demonstration of Virtual Energy Market : A SOA-based Approach

ARROWHEAD

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The **ARROHEAD** project demonstrates a service-based ICT system for **active demand (and supply) side management.** For various electricity consumers and producers (e.g., heat-pumps, dishwashers, and electric vehicles), the system issues **explicit** so-called **flex-offers** indicating their **available flexibilities in time** and **electricity amount**. The system handles flex-offer **extraction**, **aggregation**, **disaggregation**, and **issuing for trading** on a so-called Virtual Market of Energy, which supplements the existing energy markets to provide additional benefits such as cost-efficient grid-balancing, peak-reduction, distribution grid overload mitigation, etc.

DERs in households and their energy flexibilities
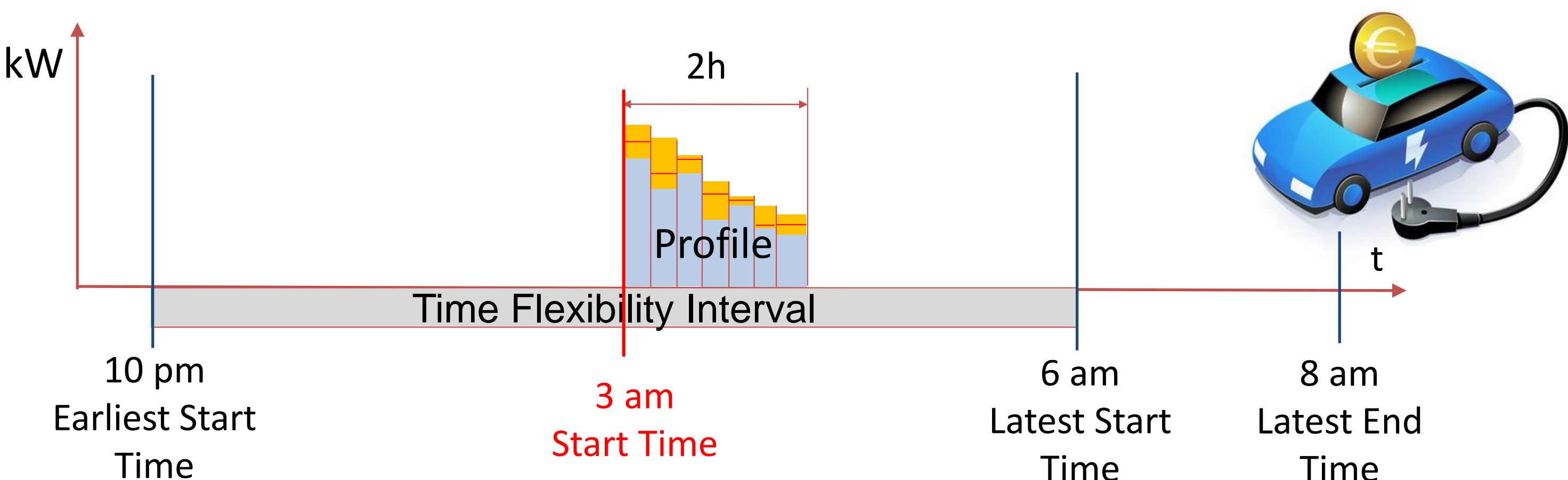
Non-flexible
- Lighting
- TV
- Computer
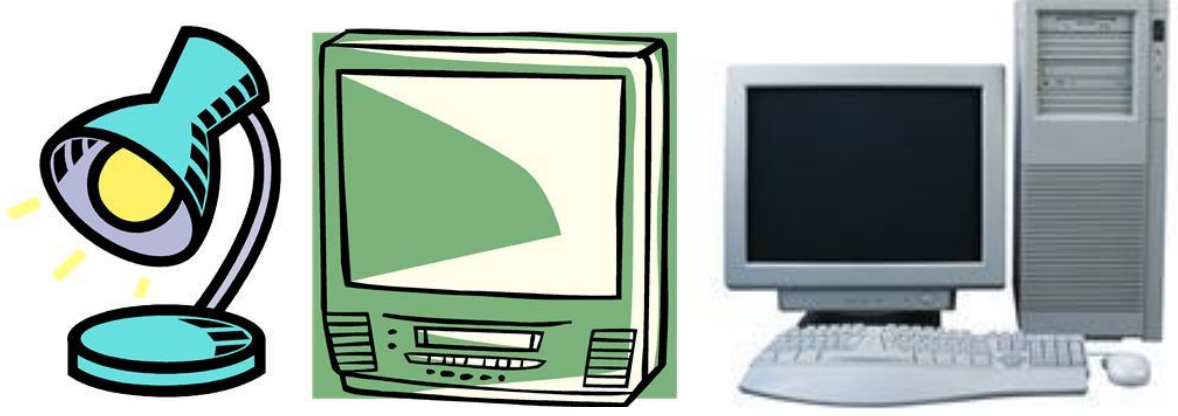
Flexible
- Dishwasher
- Heat-pumps (HPs)
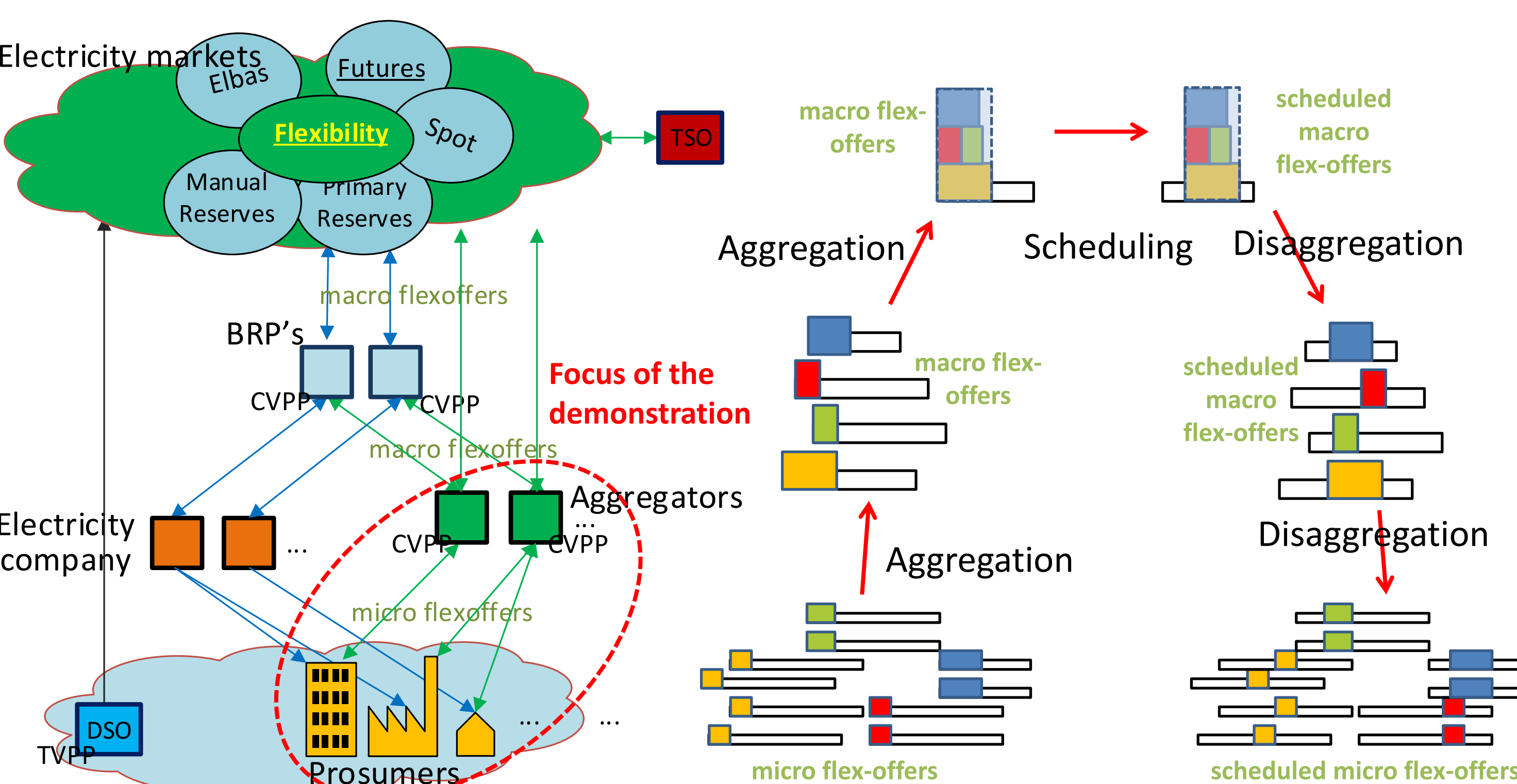- Electric vehicle

Flex-offers to capture flexibilities in DER energy use

- Captures flexibilities of different DERs in a unified manner

Trading flex-offers on Virtual Market of Energy

Main actors and operations   **Flex-Offer lifecycle**

- Flexibilities are utilized for **grid-balancing**, **peak-reduction**, **grid overload mitigation**, **reducing energy bill**, etc.

Integration challenges

- How to **integrate** existing home/appliance (e.g., HP) **automation systems** with flex-offer based virtual market of energy?
- How to **exchange flex-offers** with Aggregators, Virtual Market of Energy in a scalable and secure manner.
- How to **generate flex-offers** for specific distributed energy resources (e.g., HPs, dishwashers, etc.)?

Demonstration focus

- **On-demand generation** of flex-offers, e.g., for dishwasher
- **Continuous generation** of flex-offers for *heat-pumps* with indirect user input (e.g., setting comfort constraints)
- **Generic** service-based **software architecture** for flex-offer *generation*, *aggregation*, and *scheduling*.
- **XMPP-based exchange** of flex-offer and schedule messages

Software architecture and components
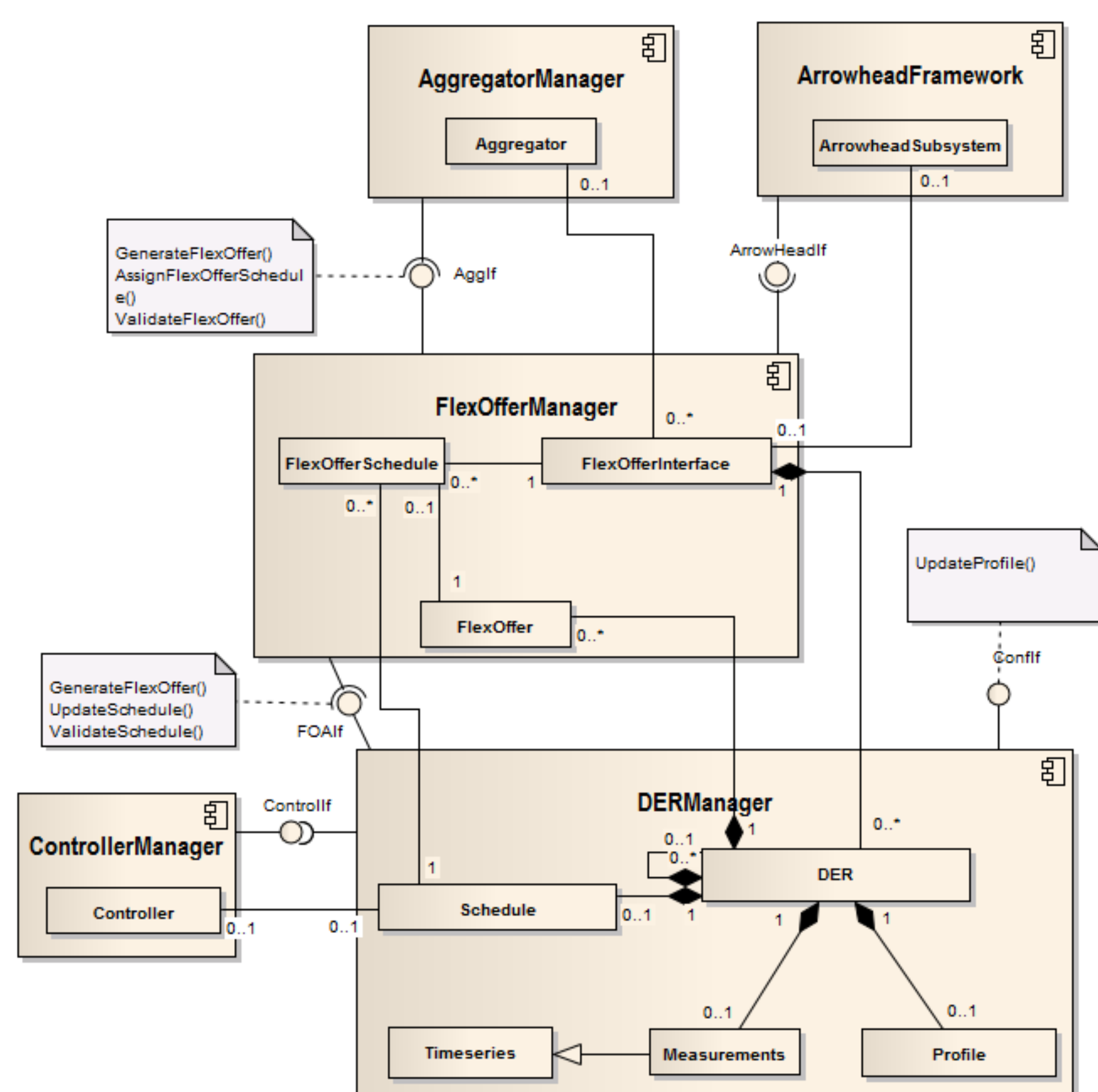
AggregatorManager
- Interfaces the market
- Aggregates flex-offers
- Disaggregates flex-offer schedules

FlexOfferManager
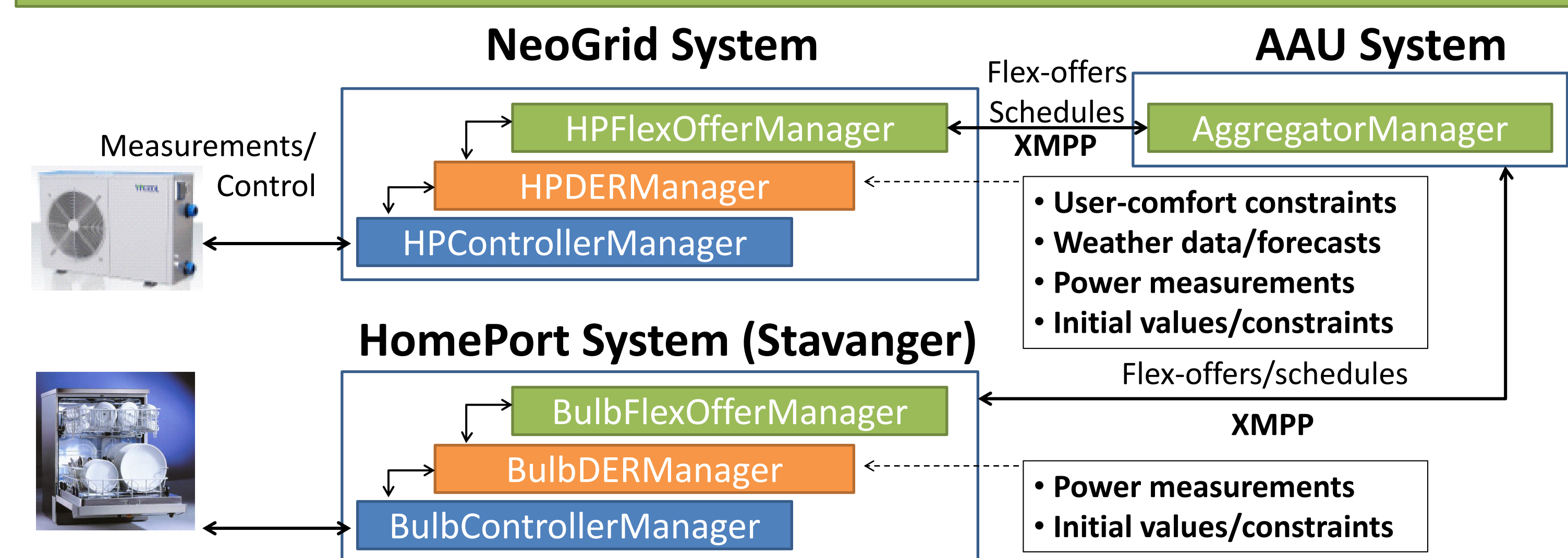- Manages a set of DERs
- Negotiates flex-offers with Aggregator

DERManager
- Produces flex-offers
- Consumers flex-offer schedules

ControllerManager
- Ensure a DER follows internal schedules

Deployment of components

Conclusion

The demonstration shows that it is possible in a effective way to aggregate the flexibility from various devices by using the flex-offer concept. This flexibility can be traded on electricity markets similar to power plants. The demonstration also shows an online communication between physical separated entities like household, aggregator and third party actor.

Acknowledgements

www.arrowhead.eu