

# Agent-Based Services for Building Markets in Distributed Energy Environments

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## Energy management system for Microgrids

Apart from the technical challenges, **microgrids** have to meet economic, environmental and legislative constraints. In order to fulfill them, microgrids require to incorporate intelligent energy management systems able to schedule the activity of the units, bargain in energy markets and follow the instructions of the System Operator.

The operation planning is based on complex factors such us: features of the DER units, amount of load that can be modulated and shed, energy prices, weather forecasts and estimations of the demand.

## Intelligent Agents

Intelligent Agents are autonomous entities capable to develop flexible action planning in distributed, shared environments in order to achieve well defined goals. Main features of intelligent agents are autonomy, goal orientation, reactivity, proactivity and social ability.

Intelligent agents are accepted as a suitable technology for managing microgrids and for representing the interests of the owners in energy markets.

## Challenges of adding Intelligent Agents

However, the adoption of intelligent agents entails important challenges that have not been properly considered:

- Agents are software programs that will require upgrading and debugging tasks that must be done by hand.
- Important tasks such as bargaining or accessing external weather forecast services turn out complex and heavy for a local device.
- Agents work as management experts, so their skills must be previously certified by an authority.

## The Agency Services model

The Agency Services Model proposes the instantiation of additional intermediary agents in the ICT infrastructure, which after being contracted as services participate in energy markets on behalf of the microgrid's local control system. These agents work as advanced external **brokers** that guarantee the interoperability of the microgrid with both energy markets and the grid.

On the client side, a limited agent is remotely deployed. It aims at integrating the control system of the microgrid with the brokering services of the ICT infrastructure. The local agent is loaded in a Java device that we term **EAS-Box**.

The agent-based services are provided by specialized firms called Agency Services Provider for Energy Management (**ASPEM**). When a user contracts its services, the ASPEM is responsible for both providing the broker agent within the ICT infrastructure and remotely loading the local agent in the client.

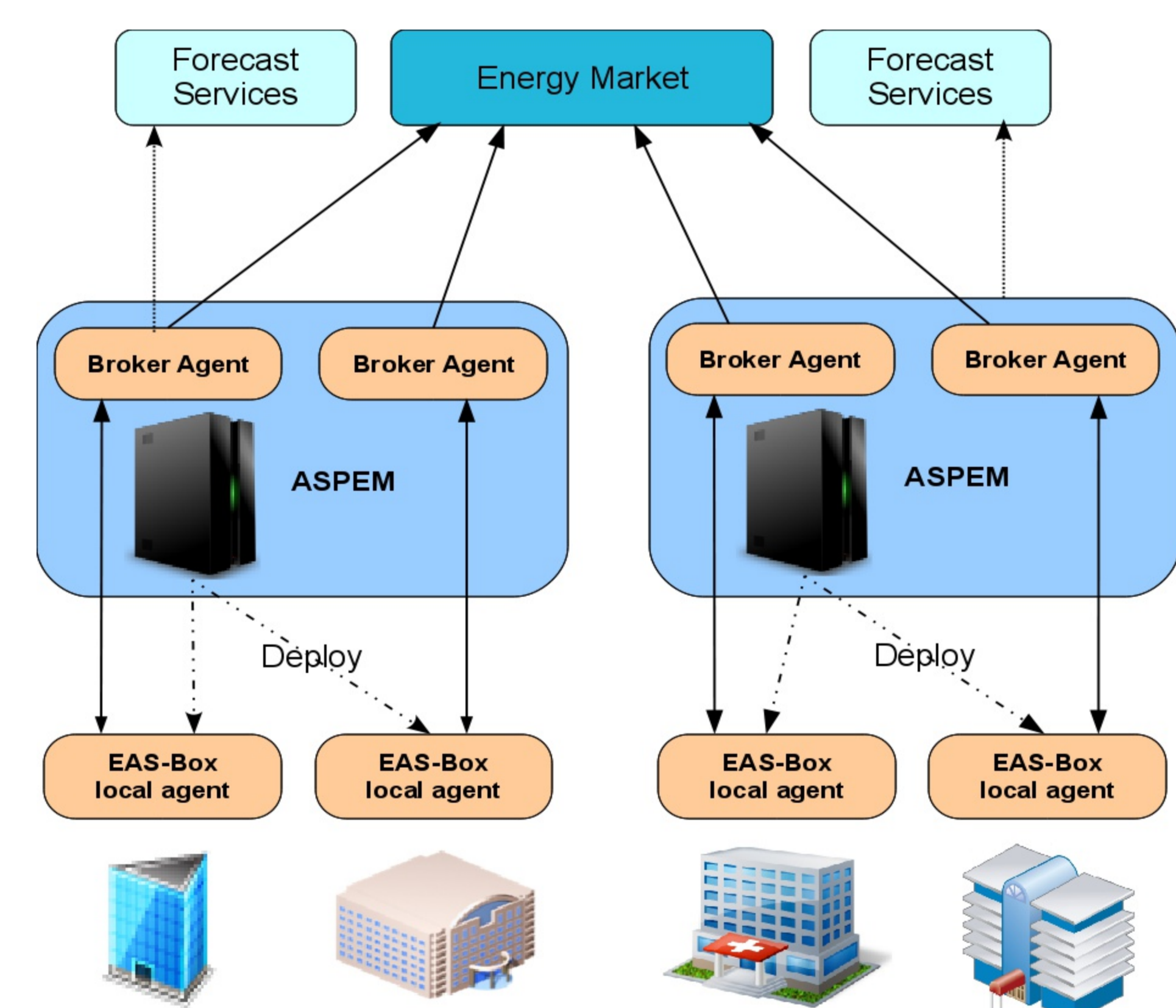
The main advantages of the Agency Services model are:

- The local control system is free from the complexity that would entail its direct participation in energy markets. The local and the broker agent help the control system of the microgrid to integrate its demand response and demand shedding mechanisms with energy markets.
- ASPEMs can automatically upgrade the software of both local and broker agents, thus configuring a more reactive energy management system.

## Example

The figure shows several buildings that represent small microgrids. They are provided with DER units such as generators, photovoltaic panels and cooling and heating systems. In order to participate in local energy markets, each building contracts the services of an ASPEM, so that:

- A broker agent is deployed within the infrastructure of the ASPEM. The broker represents the building in the market and interprets the signals of the System Operator.
- A local agent is deployed within the infrastructure of the building. It is related to the broker agent and helps to integrate the building's control system with the brokering services of the ASPEM.



*Microgrid management based on the Agency Services model*

## References

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