TaRDIS

IoT Day Webinar

IoT Supply Chain security to ensure compliance with the CRA

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Trustworthy and Resilient Decentralised Intelligence for Edge Systems

HORIZON-CL4-2022-DATA-01-03

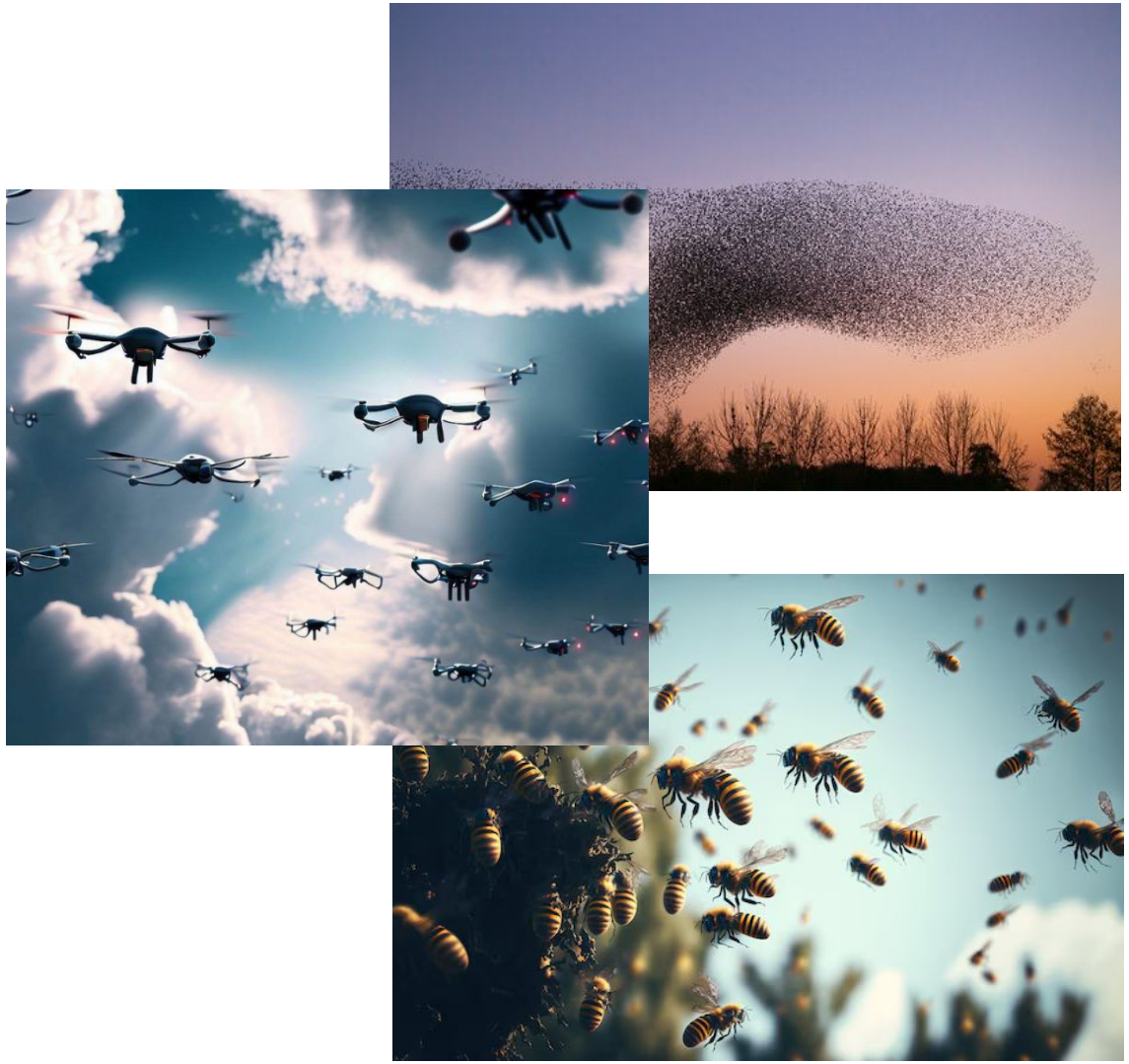
Programming tools for decentralised intelligence and swarms
RIA (TRL 5-6)

Start date:	01/01/2023
End date:	31/12/2025
Duration:	36 months
Budget:	€ 7M

What are swarm systems?

Swarm are:

- heterogeneous
- dynamic
- decentralised
- intelligent



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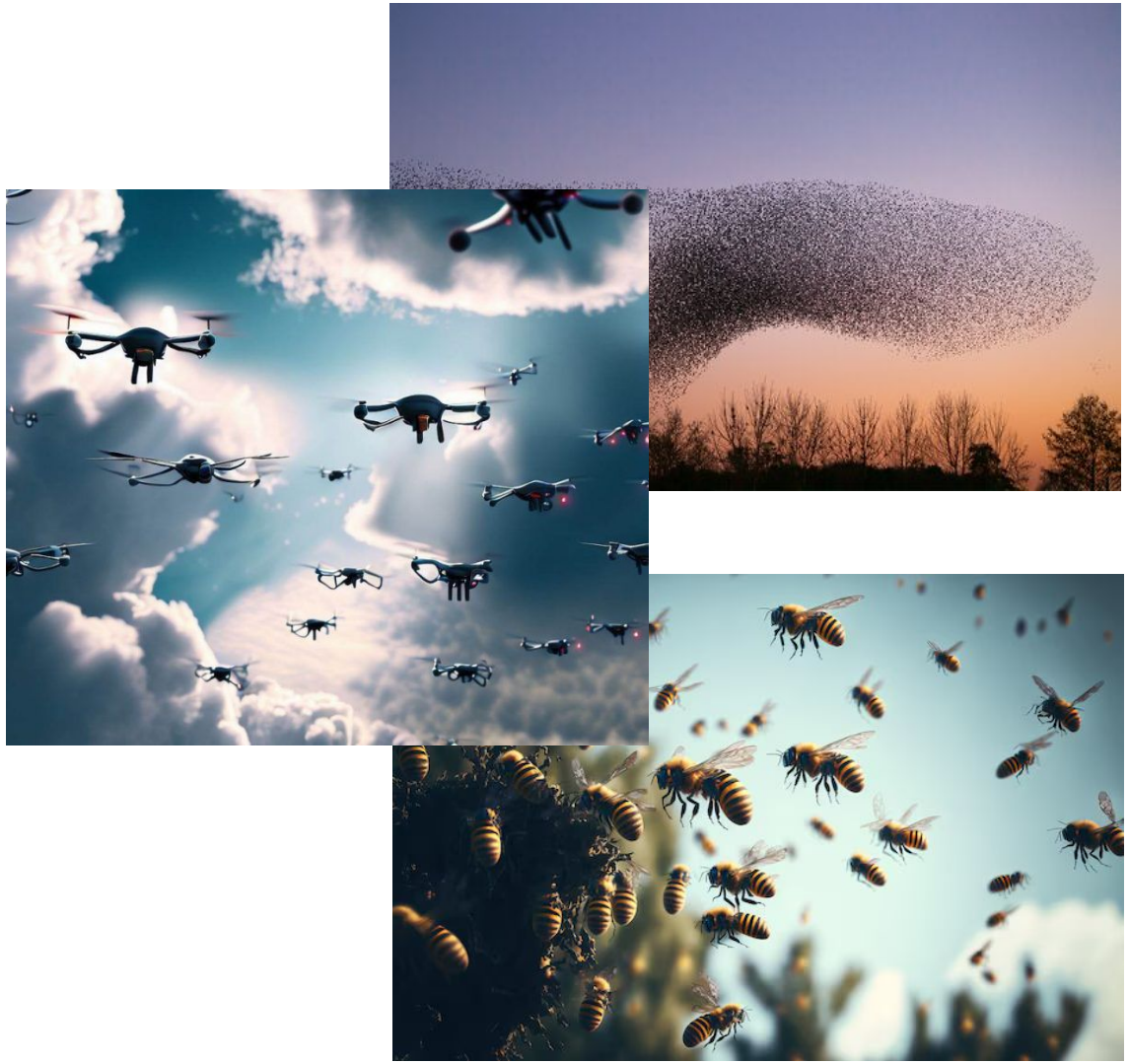

- Swarm elements actively **cooperate** towards shared **goals**, continuously **evolving** and **adapting autonomously**

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Challenges in the development of swarms

Requires deep **developer expertise** across multiple domains

- Tooling gaps
  - Lack of automated verification tools and integrated open-source tools
- Non-interoperable software stacks
  - High dependence on non-EU proprietary tools
- Decentralised Intelligence
  - Lack of mechanisms for decentralised Intelligence

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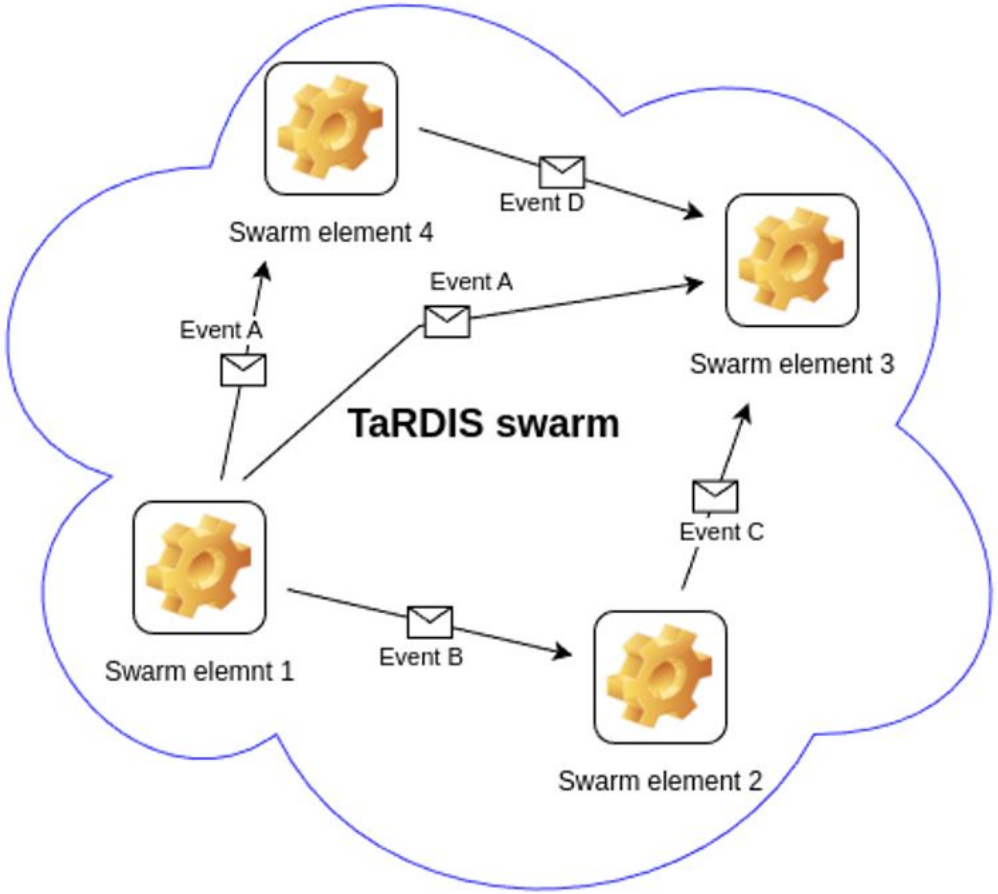
Core concepts

Event-based paradigm

Modularity

Abstraction

Compositionality



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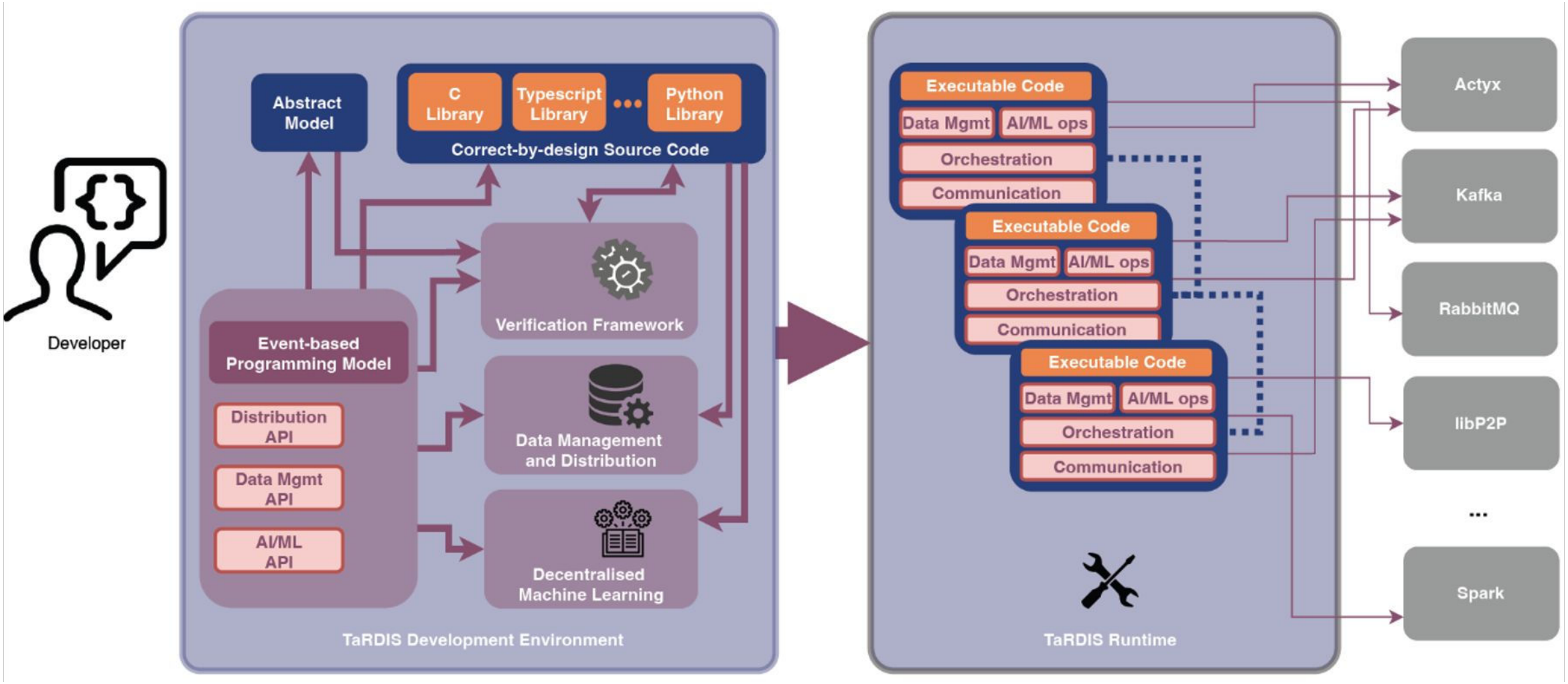
TaRDIS Toolbox



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Some technical achievements

- Event-driven programming model and supporting APIs
- Rigorous verification techniques towards correct-by-construction development
- Protocol verification for secure data channels
- Decentralised federated learning for data privacy
- Lightweight ML techniques for decentralised learning
- Decentralised distribution framework
- Adapters for interoperability with legacy storage

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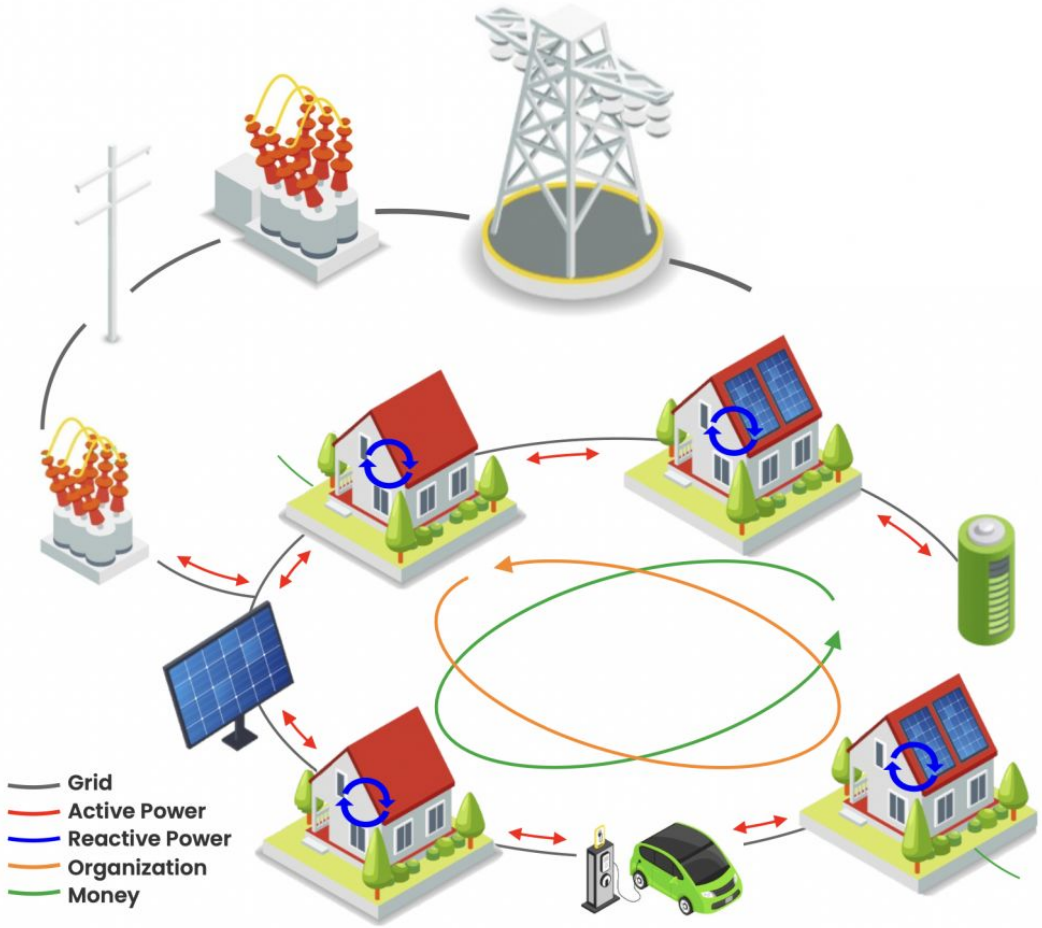
Energy communities

- **Multi-level smart charging**
  - Cheaper energy since is coming from neighbour renewables through microgrids
  - Almost carbon neutral
  - Still can use main grid as backup

- **Solution**: Handle the peers in the Energy Community as a heterogeneous swarm and let them talk!



* https://www.ped-interact.eu/

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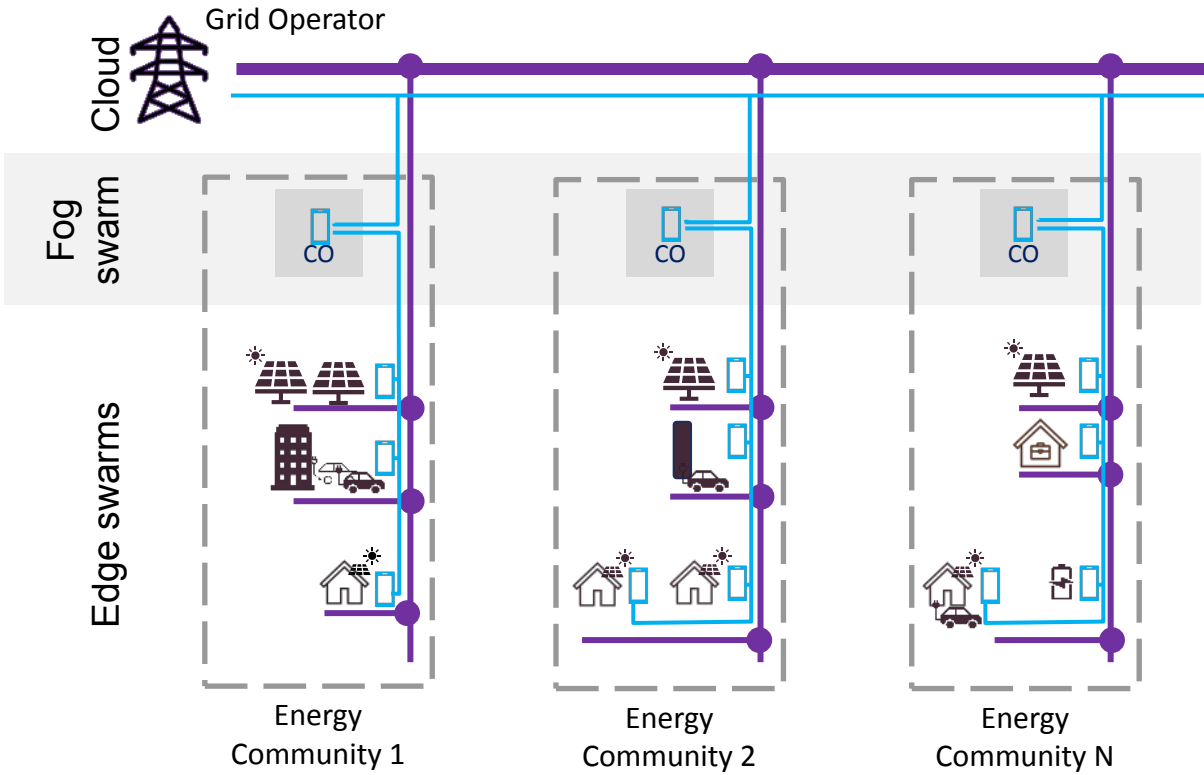
Energy communities

- **Forecast** peer energy consumption and production:
  - Decentralized federated learning techniques for data privacy
- **Reliable communication** support:
  - Decentralised distribution framework as resilient communication backbone
- **Information-flow analysis**:
  - Automatically ensures privacy compliance by protecting sensitive data
- **Simplified programming**:
  - Event-driven programming for fast, compliant development



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Conclusions and Impact

- Correct-by-design methodologies supporting CRA compliance
- Reduced reliance on non-EU proprietary technologies
- Enhanced resilience and interoperability for swarm applications

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THANKS

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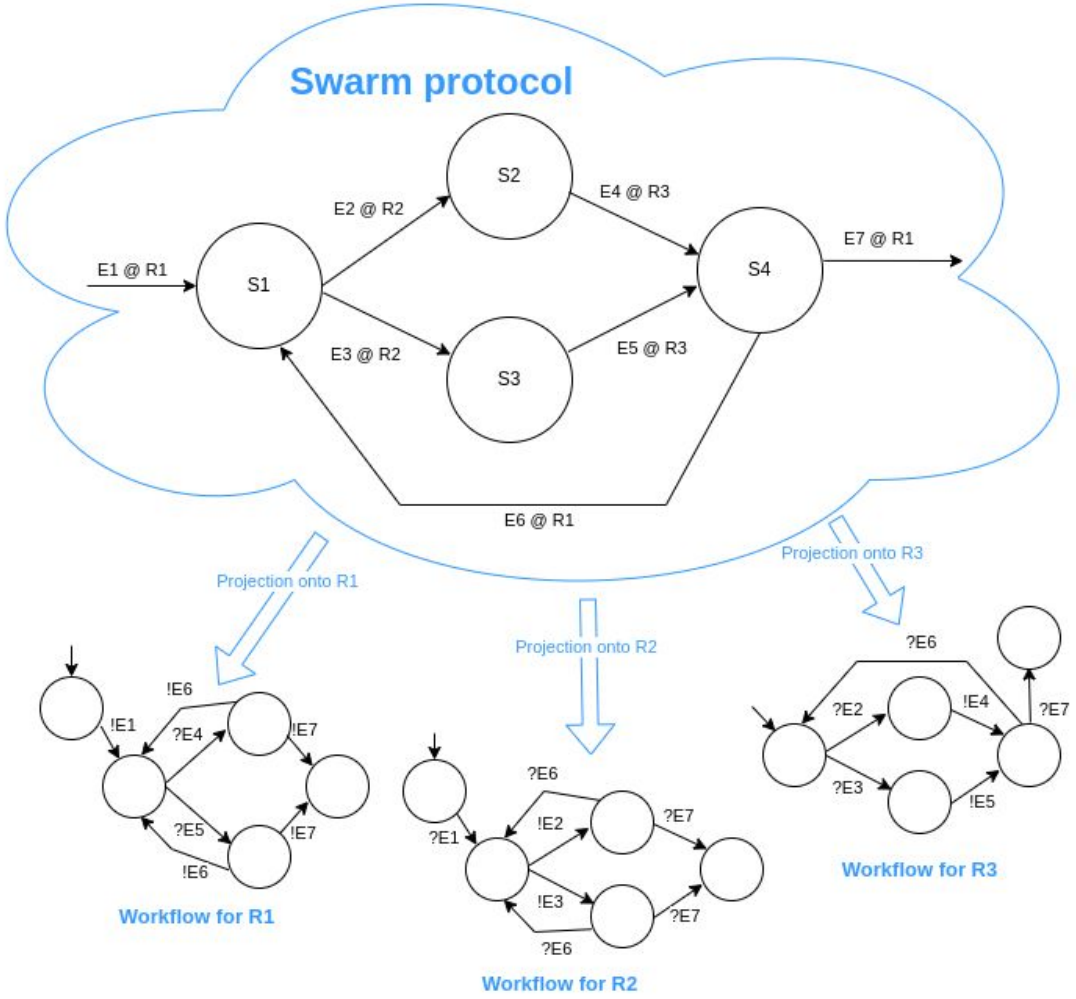
Correct-by-construction swarms

- **Swarm protocol**: global view of events
  - **Roles** emit and react to events
  - **Well-formedness** conditions

- **Workflow**: local behaviour of a swarm role
  - Says how a role consumes and emits events
  - Can be **projected from a swarm protocol**
  - Ensures **compatibility** with other workflows

- Local checks ensure global compliance



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