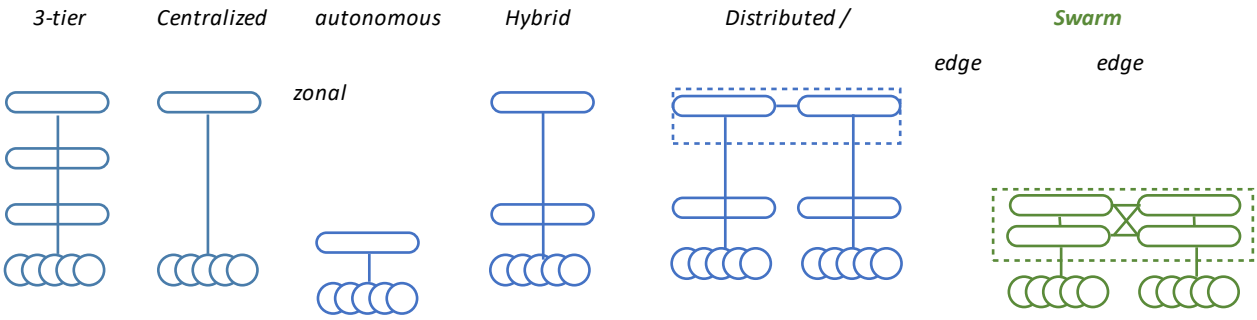
IIC Architecture - Swarm pattern

Key question	Information, compute location
Alternatives	
Stakeholder	Service/Product designer

1. Problem

Information can be kept in the things at the edge, in a central location, distributed in all those places, replicated in diverse locations or can follow many creative schemes. In the same idea, applying logic on the information can be done at several places:



In those diagrams, rounds represent things which can be sensors, controllers. The rectangular objects represent levels/nodes of data handling and/or storage.

Distributed or Zonal pattern is a case where a number of systems collaborate to solve the problem. The presence of horizontal links intend to picture intra-level communication as opposed hierarchical communications nature of the 3-tier or centralized patterns.
The « geographic dispersion » can be between states in USA or between zones in a car (rear/left, rear/right, front/left, front/right, central1, central2).

The swarm pattern is a dynamic collection of collaborative nodes such as cars in a platoon.

Choosing one pattern can be either difficult or almost imposed by regulatory or operational constraints. Each pattern is described in a specific pattern document. Pattern description

2. Description

The swarm pattern is the only pattern that accommodates dynamic creation of ad-hoc communities of computing elements that need collaboration to make decisions.

This pattern is usually an additional pattern to complement other ones. For instance an autonomous car is built essentially following autonomous edge pattern but can build on swarm pattern for platooning.

2.1. Solution

Autonomous entities may need some collaboration to enhance efficiency. The decision making otherwise independent rely on diverse computing models (see different patterns for the computing model architecture class) inside the swarm or between swarms.

Data may not be store except for incident forensics or regulatory constraints.

Swarms may involve static elements. For instance traffic lights controllers may be used during orchestration of two car platoons crossing, road infrastructure itself may be part of setup and operation of multiple car platoons.

2.2. Model

Participants to the swarm discover themselves and exit the swarm based on wireless reachability. Once connectivity is established, the computing model (see computing model patterns such as layered data bus) is either established (2 participants) or extended (>2 participants) is made operational.

Following computing model establishment, participants exchange data to make decisions. For instance one participant may detect an incoming lateral car and the platoon collectively decide to split itself in accelerating parties and breaking parties.

In addition to intra-swarm collaboration, there can be inter-swarm collaboration. For instance two platoons at an intersection are cooperating to create enough inter-car space and adapt speed to allow stop-less intersection passing.

2.3. Stakeholder

This pattern is intended for the service or product designer that need to weigh efficiency, costs and possible regulatory constraints when choosing an overall system pattern such as the autonomous edge

3. Guidance

3.1. Advantages

The only pattern of its kind to address dynamic collaboration between otherwise autonomous entities.

3.2. Disadvantages

Very complex to design, setup, test and certify.

4. Application notes

See more on applying the pattern in:

- Autonomous driving / swarm pattern