Architectural Modelling Patterns for Systems of Systems

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Pattern 1: Centralised

- Central point of control
- “Hub” connected to other CSs, responsible for delivering SoS behaviour
- Hub typically developed specifically for SoS
- May or may not force all CSs to communicate through the hub(s)

- Subtypes:
  - Fully centralised
  - Distributed hub
  - Hierarchical series of hubs
Pattern 2: Reconfigurable Control

• Pattern to support dynamic reconfiguration

• Requires some provisions:
  • CS functionality and (optionally) QoS must be specified
  • Alternatives are available for these functions
  • SoS can monitor current performance

• A policy details when and how to reconfigure

• SoS

• Explicit reconfiguration control CS can monitor CS functionality & performance to decide on actions
Pattern 3: Pipe & Filter

- Data or materials processed from input form to output form
- Filters represent the processing steps
- Pipes represent connections between Filters
- Filters are independent, do not share state or know each other’s identities
- Filters can easily be re-ordered, replaced, added, removed

Garlan & Shaw 1996, Buschmann et al. 1996
Pattern 4: Supply Chain

A specialised pipe-and-filter
- Suppliers/integrators are the “filters”
- Logistics acts as a “pipe”

Differences with pipe-and-filter:
- Logistics shares internal state and participate actively
- CSs may be aware of the final goal
- CSs may be aware of internal status of their peers
- CSs are also capable of generating input to be returned upstream
Pattern 5: Infrastructure Grid

- Delivers critical civil infrastructure, e.g., power, water, roads, communications, etc.
- Divided into fixed geographical regions, each operated by an autonomous controller.
- One region can be treated as a CS.
- CSs exchange flows with direct neighbours only, and data with any other CS.
- Optional central authority.
- May optionally be a hub for communications.

Differences from pipe-and-filter:
- CSs know identity of neighbours.
- The flow may be bi-directional.
- CSs may share details of internal state.