

# Architectural Modelling Patterns for Systems of Systems

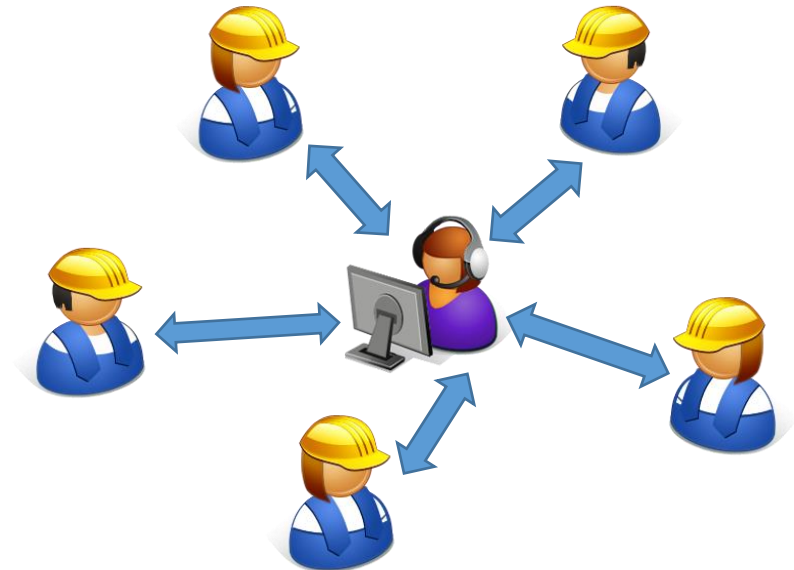
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These patterns were presented as part of a paper on SoS Architectural  
Patterns at the INCOSE 25<sup>th</sup> Anniversary International Symposium 2015,  
Seattle, WA



# Pattern 1: Centralised

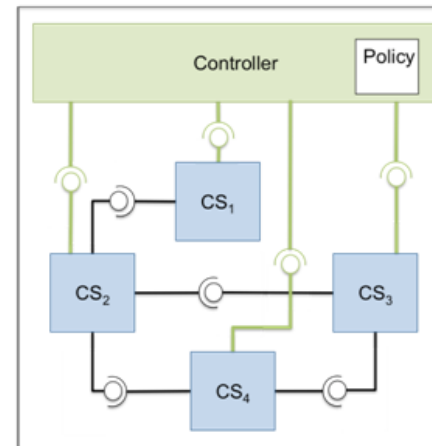
- Central point of control
- “Hub” connected to other CSs, responsible for delivering SoS behaviour
- Hub typically developed specifically for SoS
- May or may not force all CSs to communicate through the hub(s)
- Subtypes:
  - Fully centralised
  - Distributed hub
  - Hierarchical series of hubs



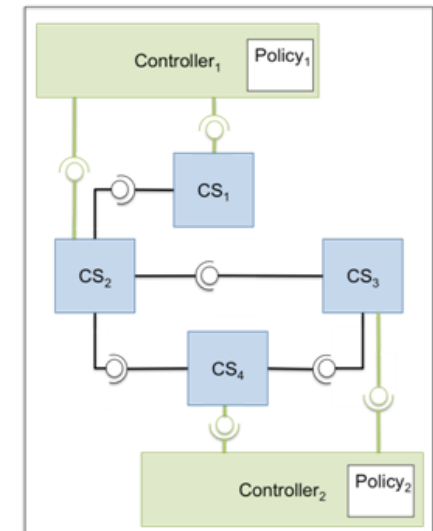
# Pattern 2: Reconfigurable Control

- 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

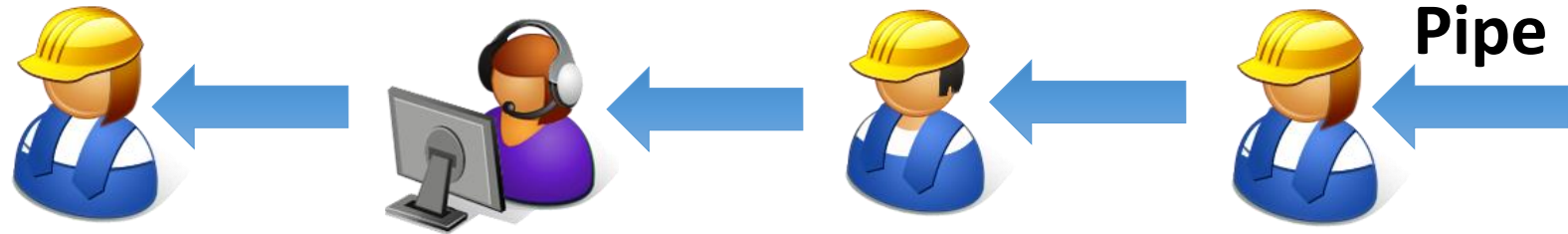
## Centralised



## Decentralised



# 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



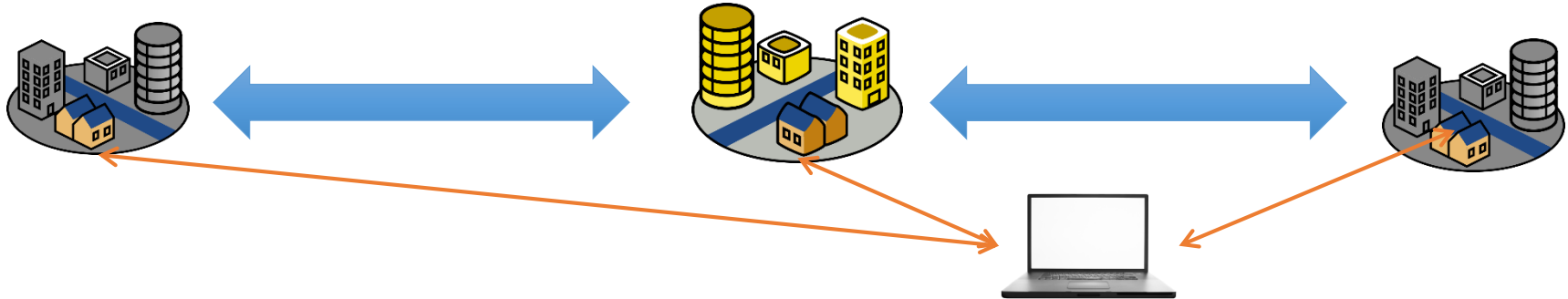
A specialised pipe-and-filter

- 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