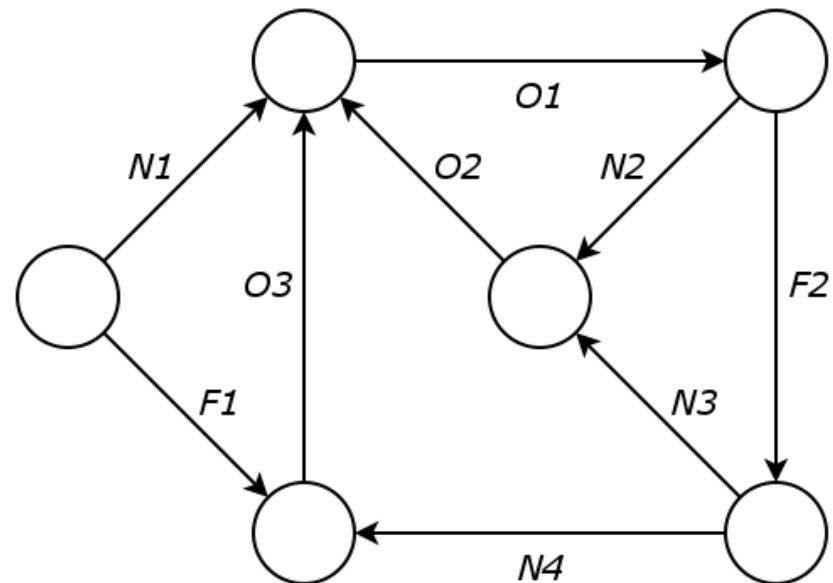


# Diagnosability Analysis of Distributed DES

# Model-based Diagnosability of DES

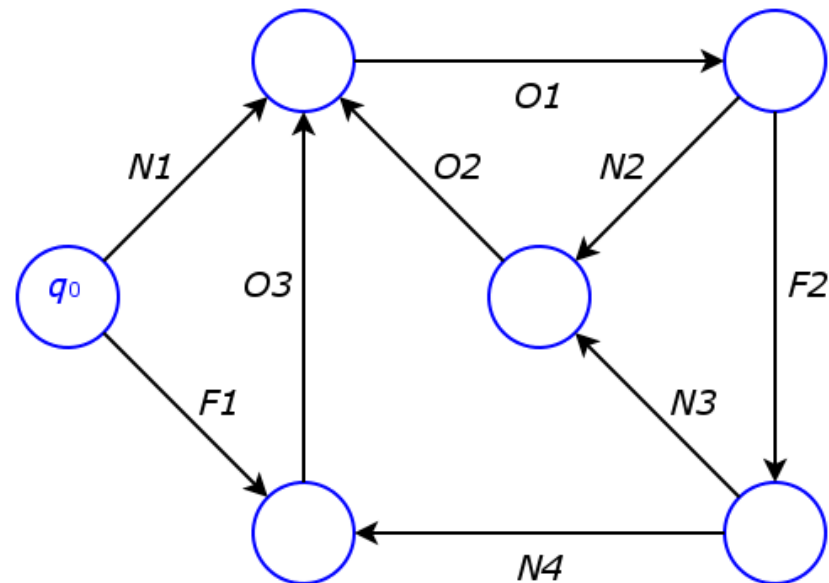
- Discrete Event System Model :
  - Automaton  $\Gamma = (Q, \Sigma, T, q_0)$



# Model-based Diagnosability of DES

- Discrete Event System Model :
  - Automaton  $\Gamma = (\mathbf{Q}, \Sigma, \mathbf{T}, \mathbf{q}_0)$

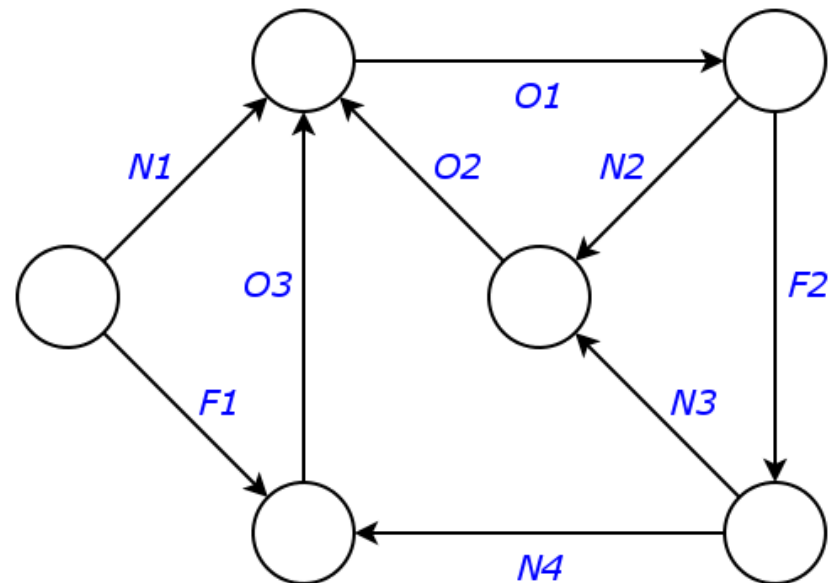
- $Q$  : set of states
- $q_0$  : initial state



# Model-based Diagnosability of DES

- Discrete Event System Model :
  - Automaton  $\Gamma = (\mathbf{Q}, \Sigma, \mathbf{T}, q_0)$

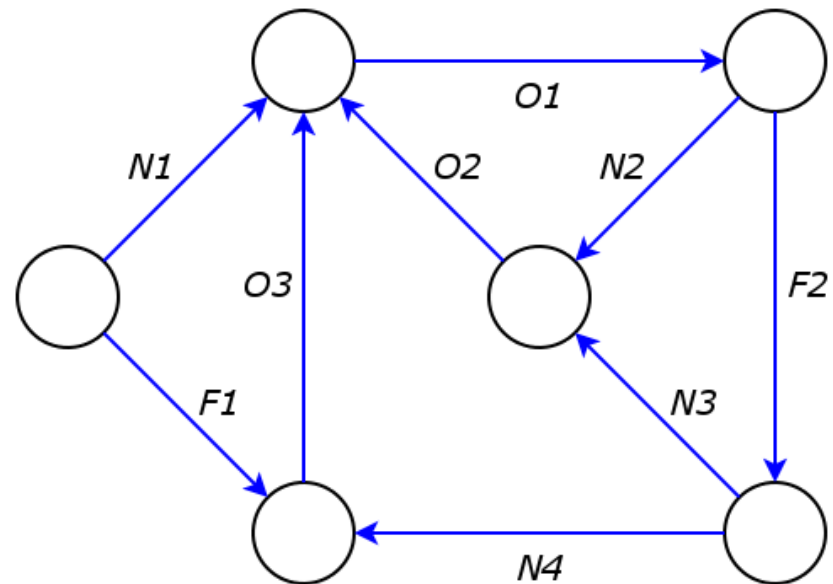
- $\Sigma$  : set of events
- $\Sigma_{\text{obs}} = \{O_i\}$   
observable events
- $\Sigma_{\text{unobs}} = \{N_i, F_j\}$   
unobservable events



# Model-based Diagnosability of DES

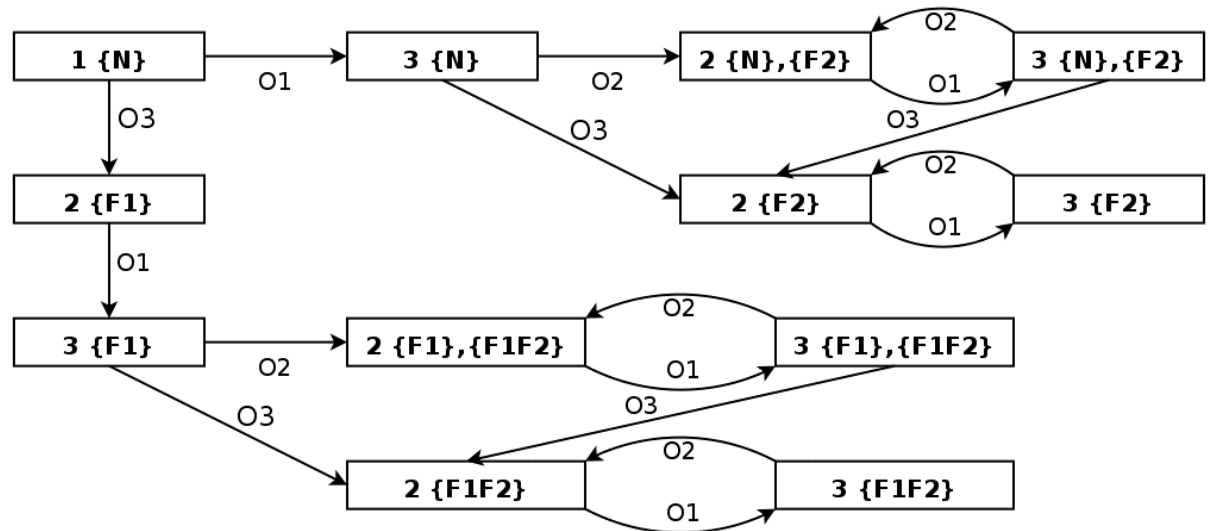
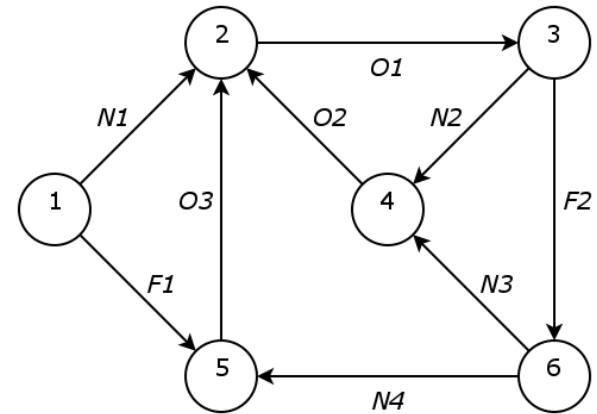
- Discrete Event System Model :
  - Automaton  $\Gamma = (\mathbf{Q}, \Sigma, \mathbf{T}, q_0)$

- $T$  : set of transitions
- $T$  is a subset of  $(Q \times T \times Q)$



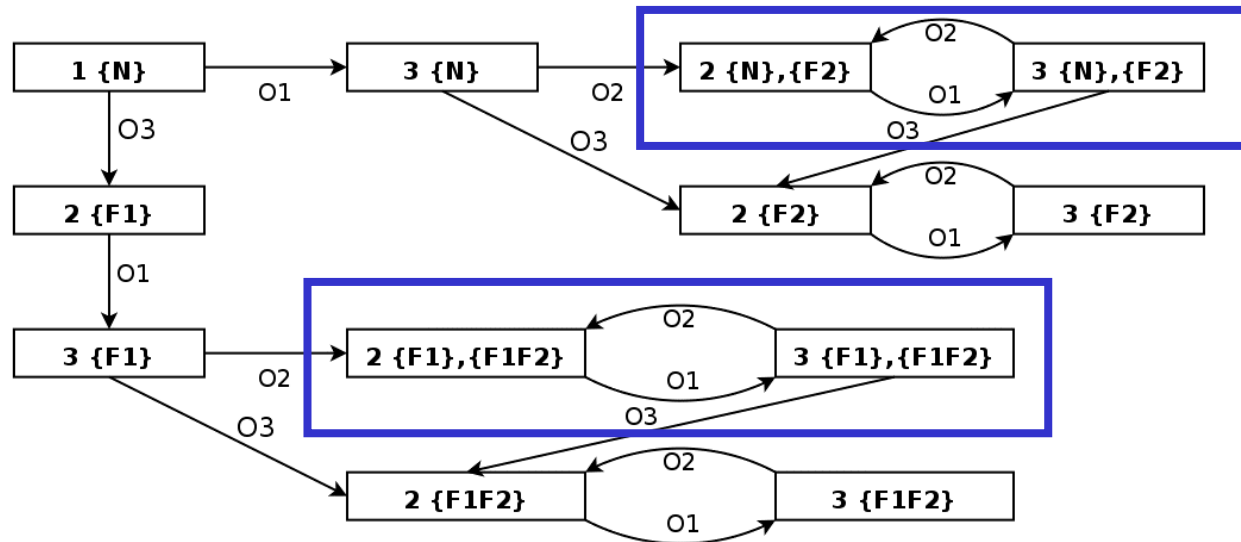
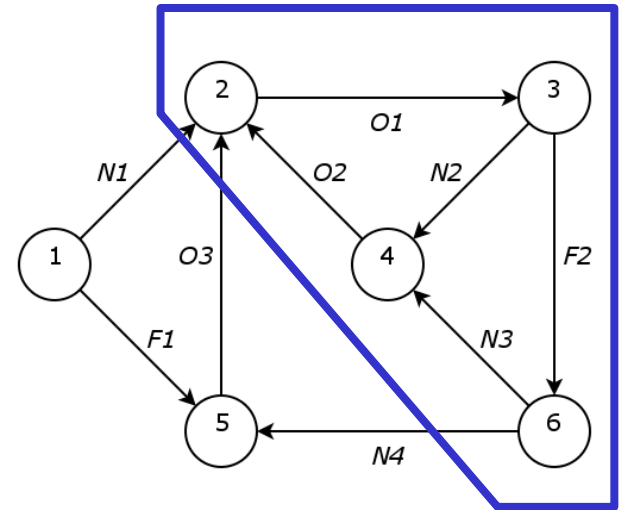
# Diagnosis in DES

- The diagnoser :
  - Built from automaton projection on observable events
  - Provides a current state estimation
  - Provides a diagnosis



# Diagnosability in DES

- Indeterminate cycle :
  - Automaton cycle associated with an indeterminate diagnosis in each state



# Diagnosability in DES

- A system is diagnosable iff the observations allow to emit a determinate diagnosis in a finite time after the occurrence of a fault.

- Criterion based upon diagnoser analysis

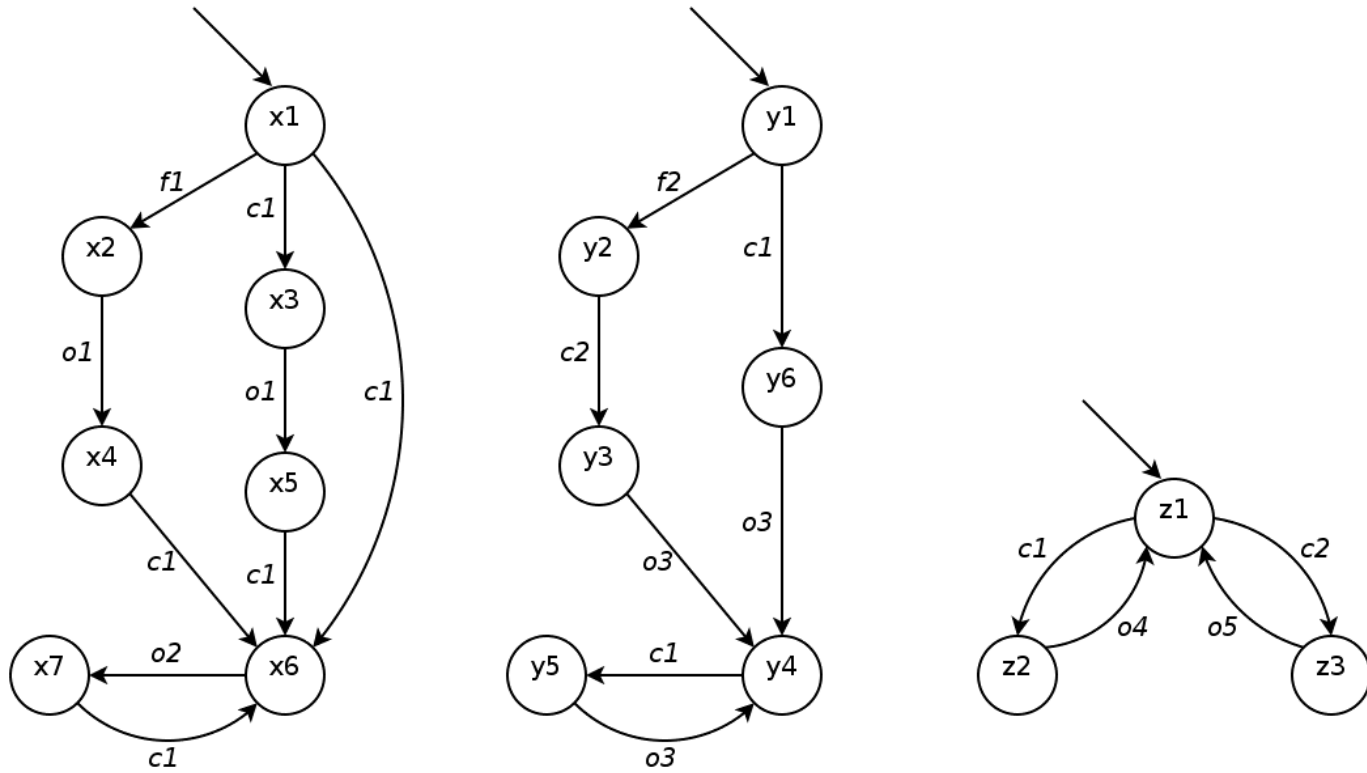
System diagnosability  $\Leftrightarrow$  Absence of indeterminate cycles



# Distributed DES

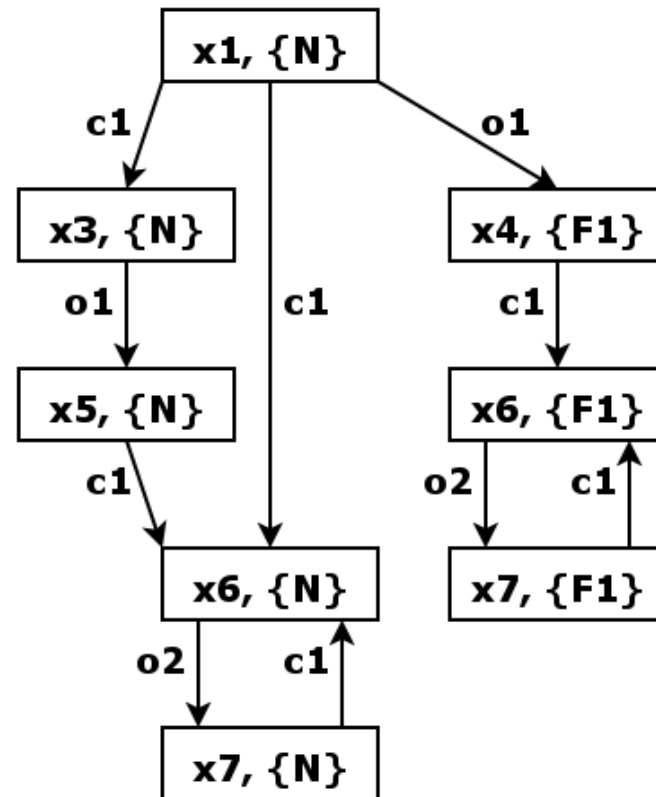
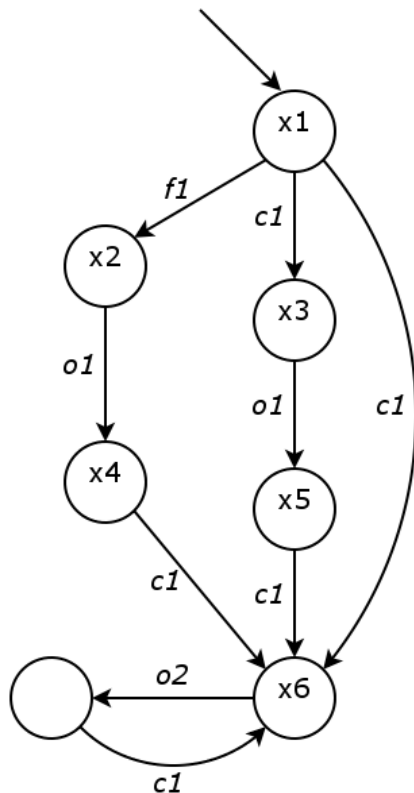
- System compound of several subsystems
  - Each subsystem is modeled as a DES
  - Global model = synchron product of submodels
  - Can be huge and expensive to compute
- New event type : communication event
  - Occurs when two subsystems are communicating
  - Unobservable
  - Notation :  $C_i$

# Distributed DES



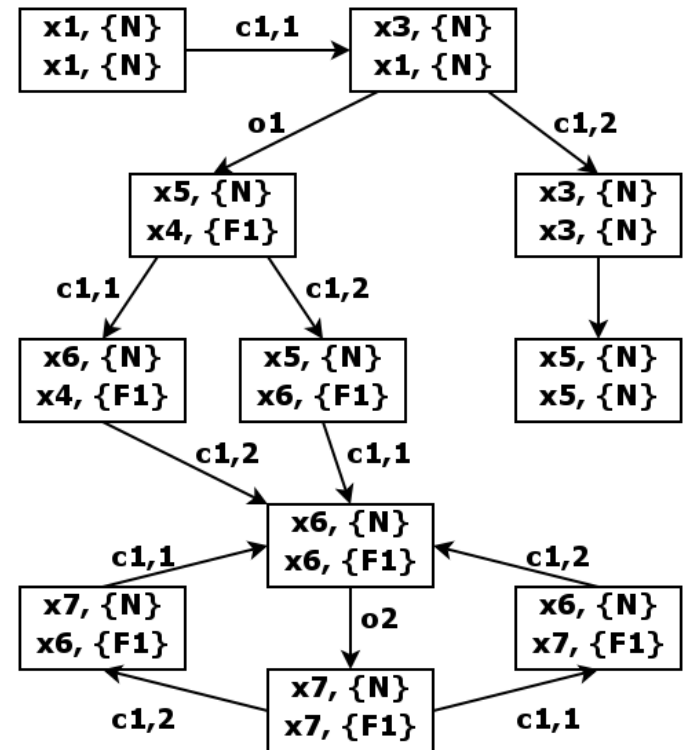
# Local diagnoser

- Interaction with other subsystems :
  - Projection on observable events and communication events



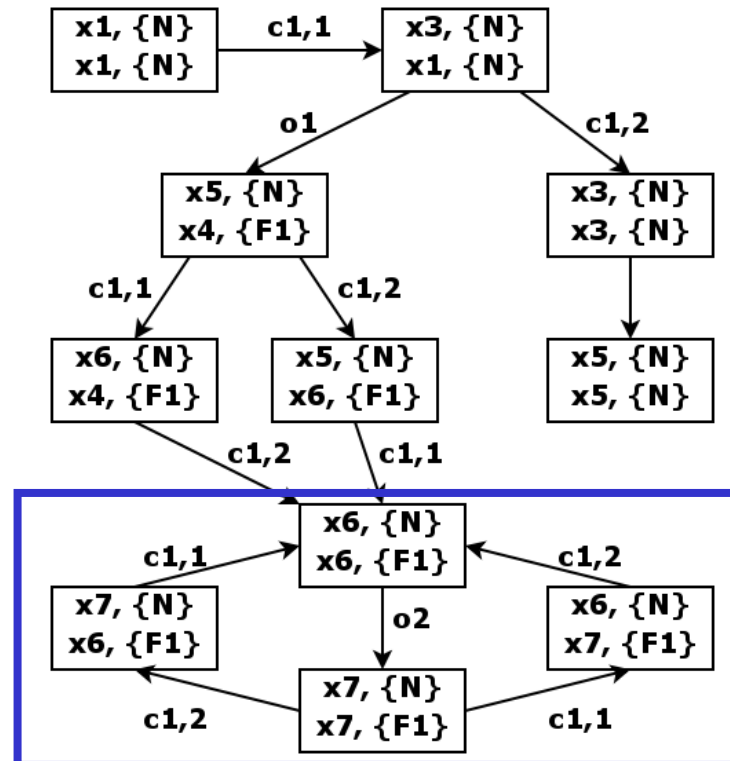
# Local verifier

- Constructed by synchron product of the interactive diagnoser with itself, over the set of observable events.



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- Constructed by synchron product of the interactive diagnoser with itself, over the set of observable events.
- Used to find indetermined cycles
- If there are some :  
« merge » the local verifier with other local verifiers



# Diagnosability

- Merging : synchron product with another verifier
  - Only involves the ambiguous cycle
- If all local verifiers have been merged and the cycle remains, the system is undiagnosable.

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