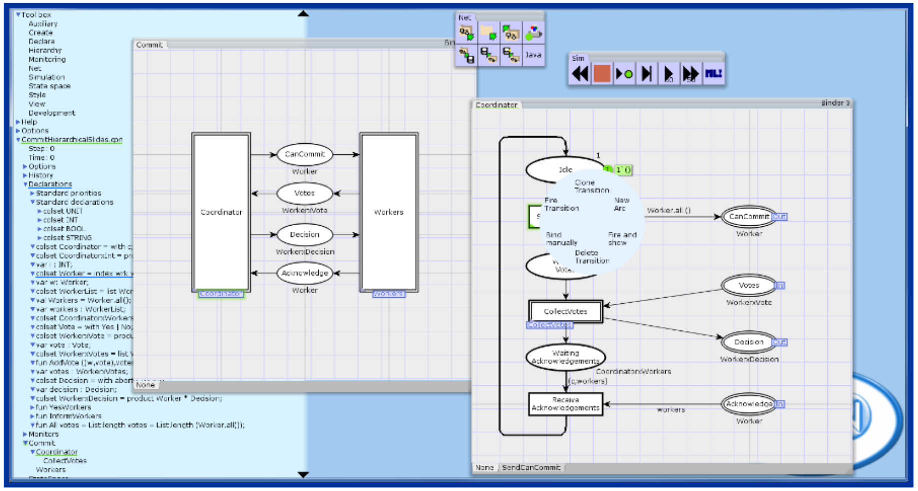
Lecture 2

Modelling with Place/Transition Nets



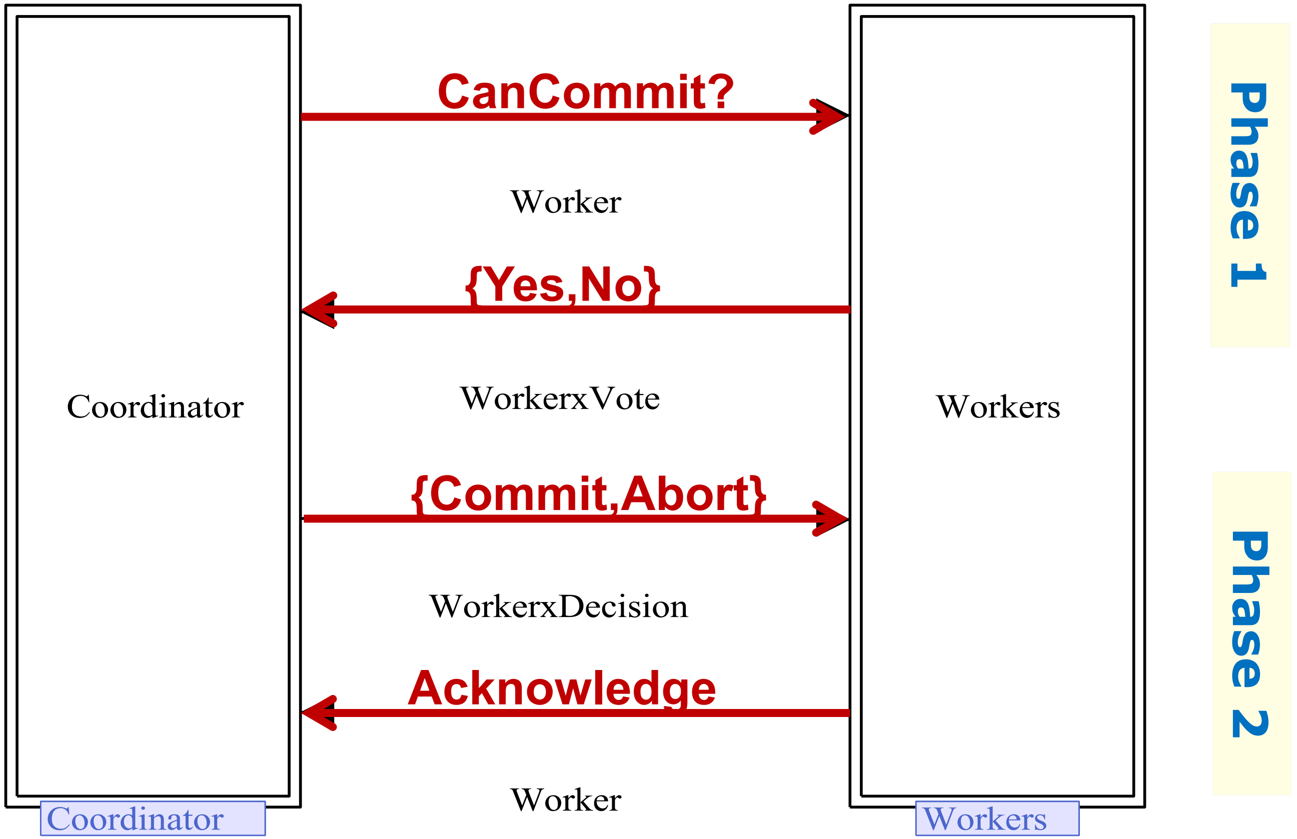
Lars M. Kristensen
Department of Computing, Mathematics, and Physics
Western Norway University of Applied Sciences
Email: lmkr@hvl.no / WWW: home.hib.no/ansatte/lmkr

Overview

- **Syntactical elements (structure)**
  - Places and Transitions
  - Arcs and arc weights
  - Initial marking
- **Semantical concepts (dynamics/execution)**
  - Tokens and current marking
  - Transition enabling and occurrence
  - Concurrency, conflict and non-determinism

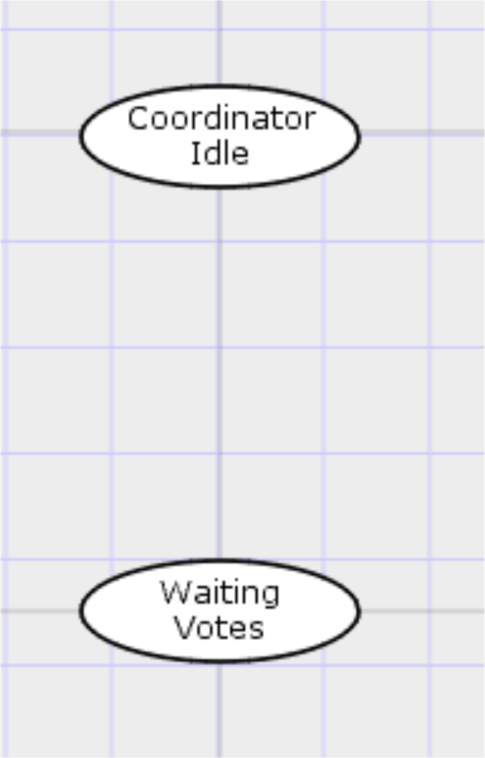
Two-phase
Commit Transaction Protocol

- We will focus on modelling the first phase



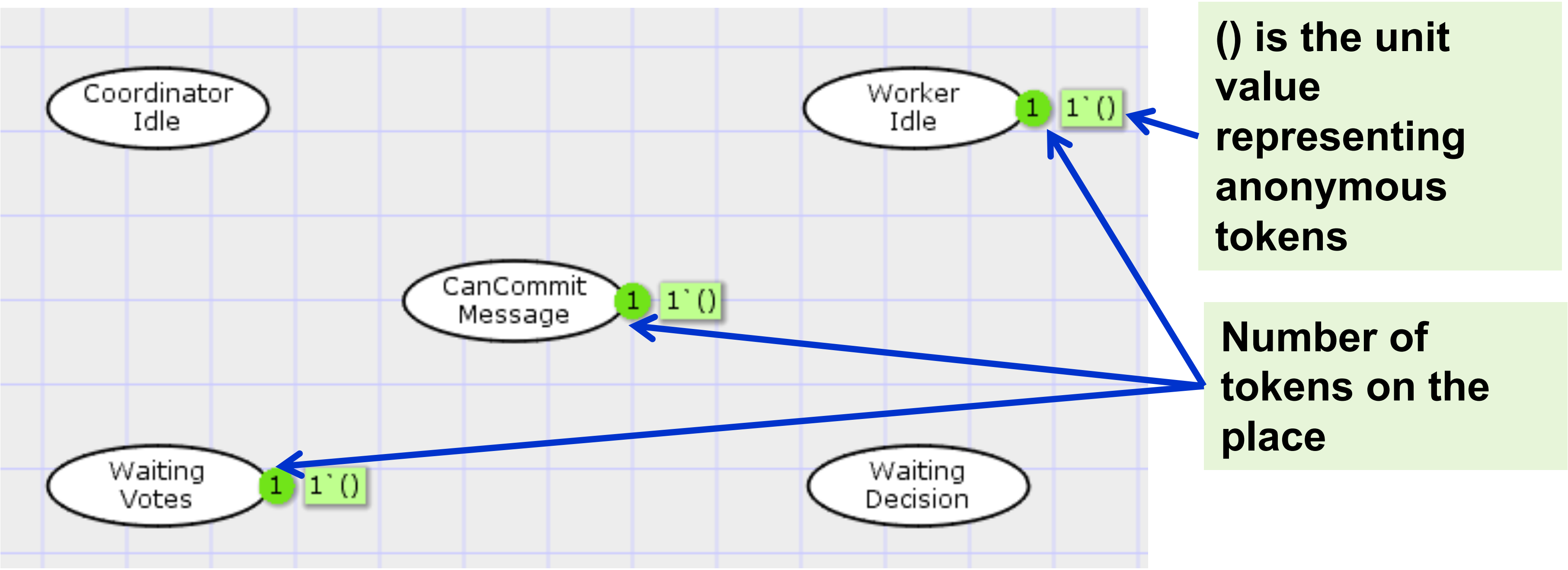
Places

- Used to model the state of the system - drawn as ellipses



Tokens and Markings

- A place can contain a number of **tokens**



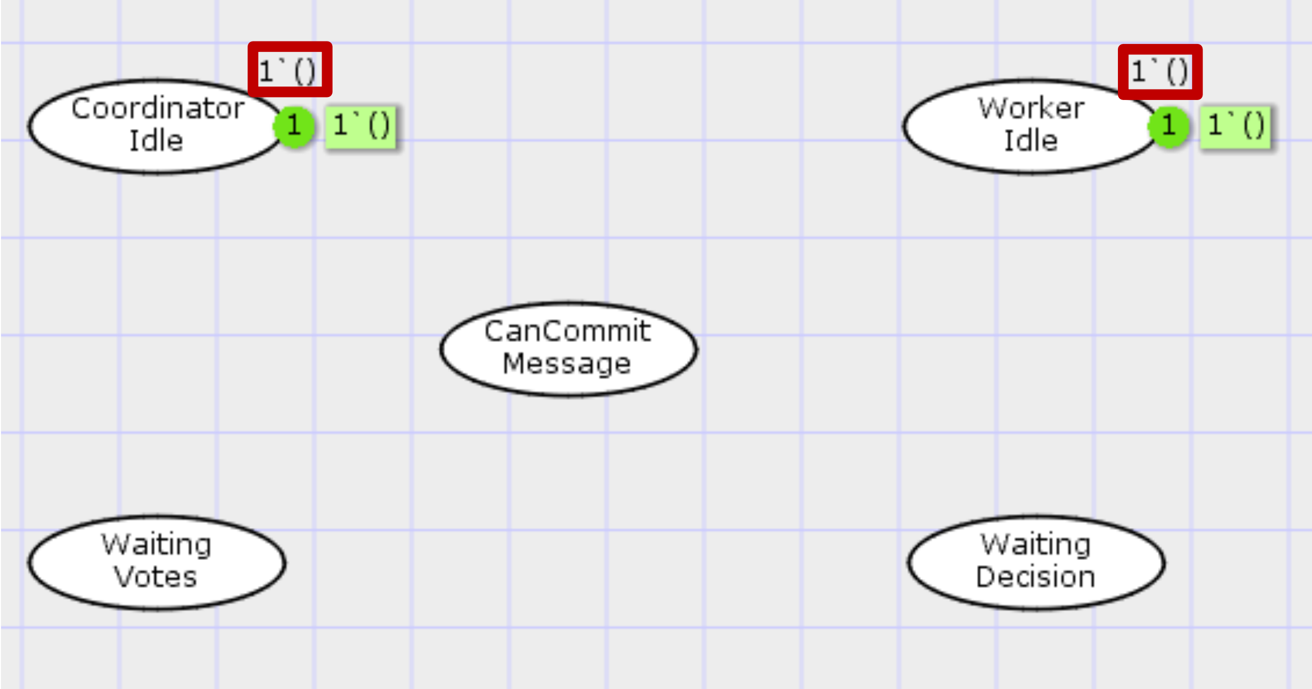
() is the unit value representing anonymous tokens

Number of tokens on the place

- A **marking** is a distribution of tokens on the places representing a system state.

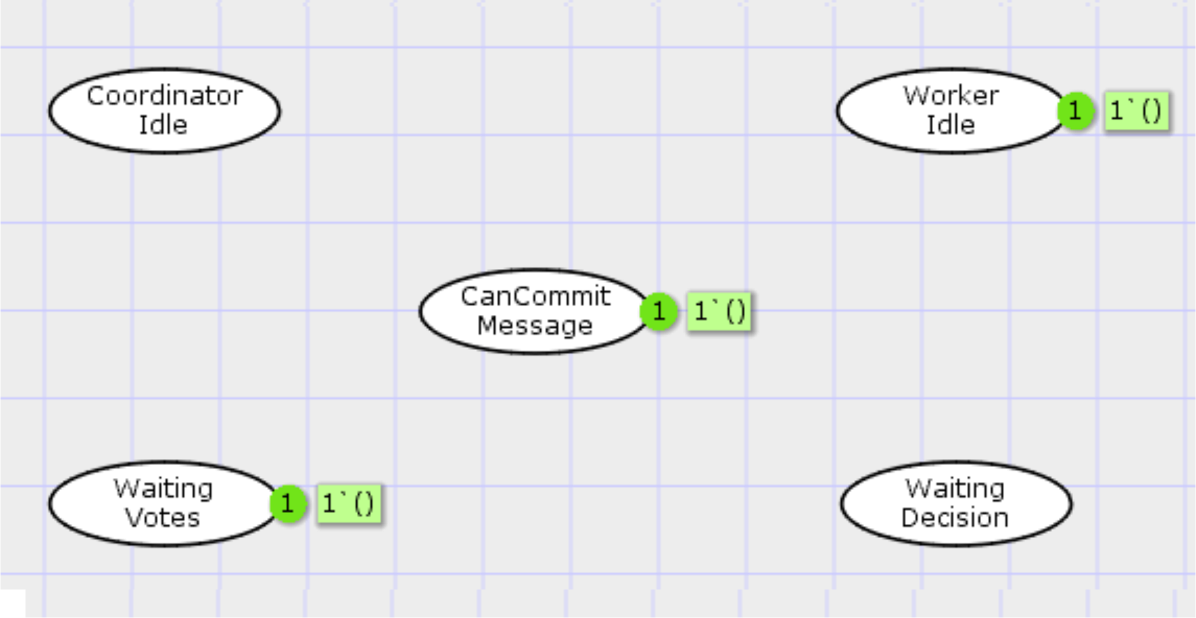
Initial Marking

- The **initial marking** (token distribution) represents the initial system state.
- Specified by giving the number of tokens that are initially present on a place



Current Marking

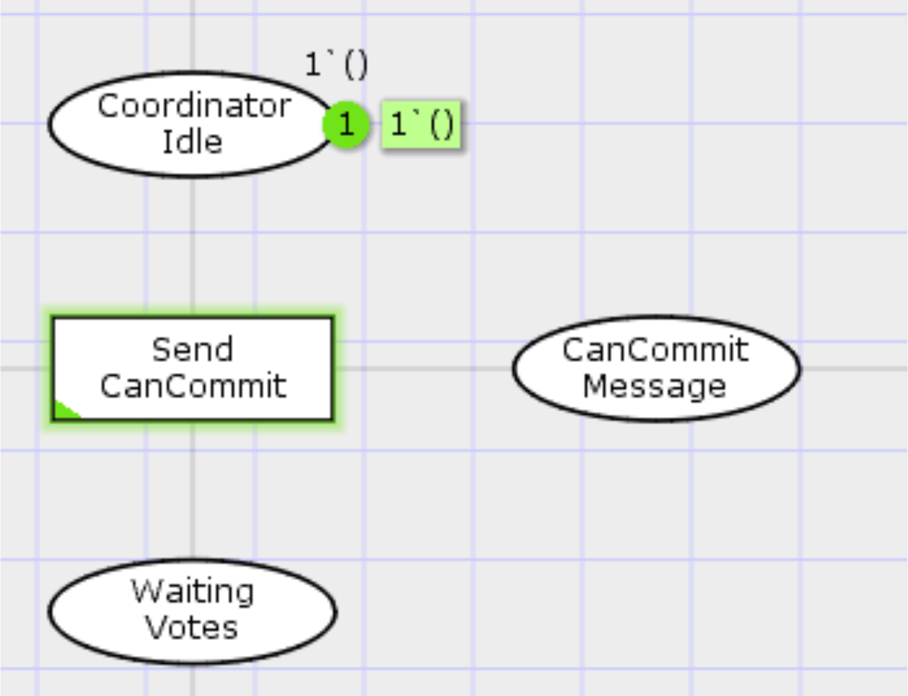
- Current marking is representing the state tha the system is currently in



- Starts being equal to the initial marking but changes when the model is executed.

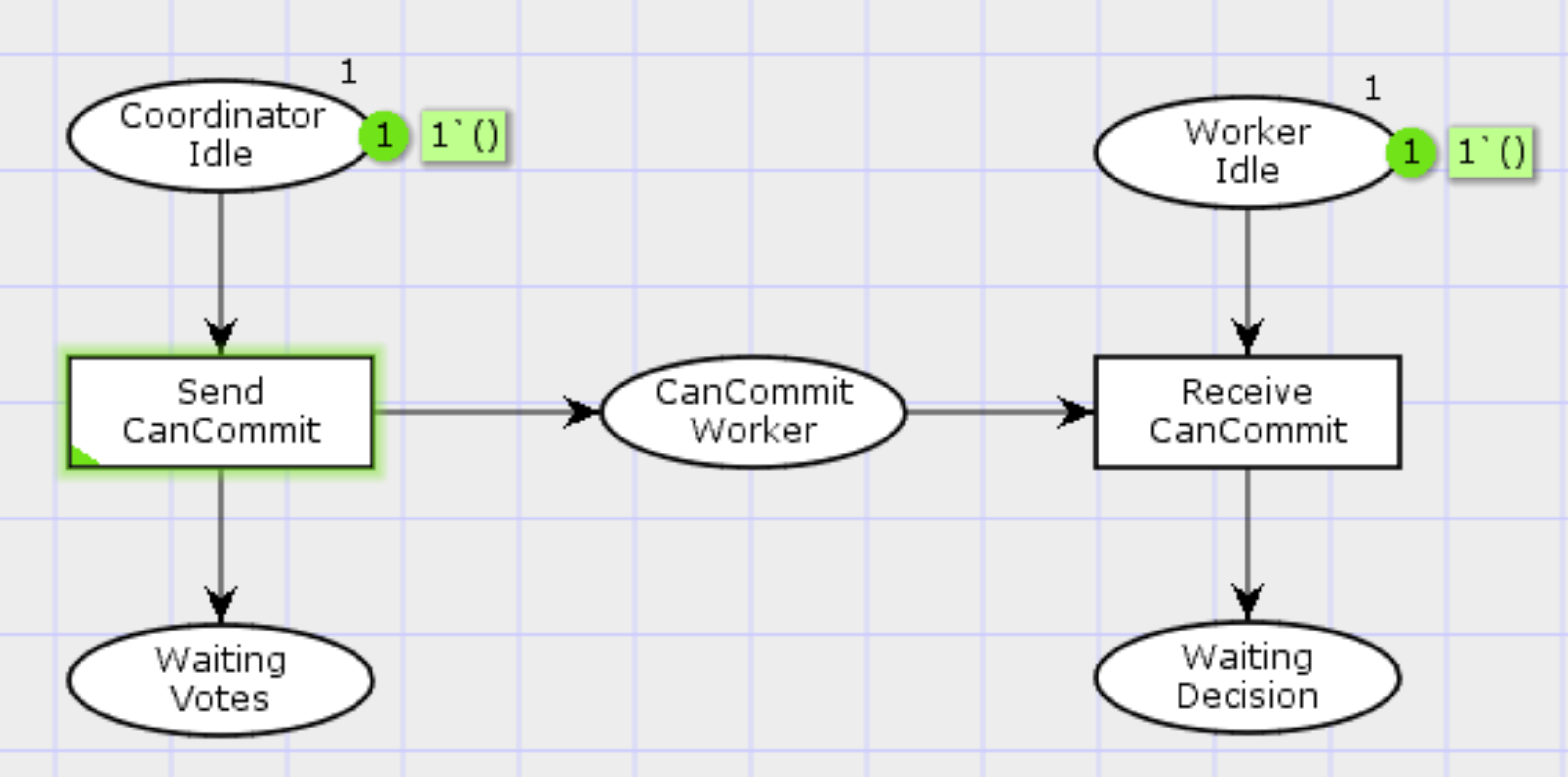
Transitions

- **Used to model the actions/events in the system - drawn as rectangles**



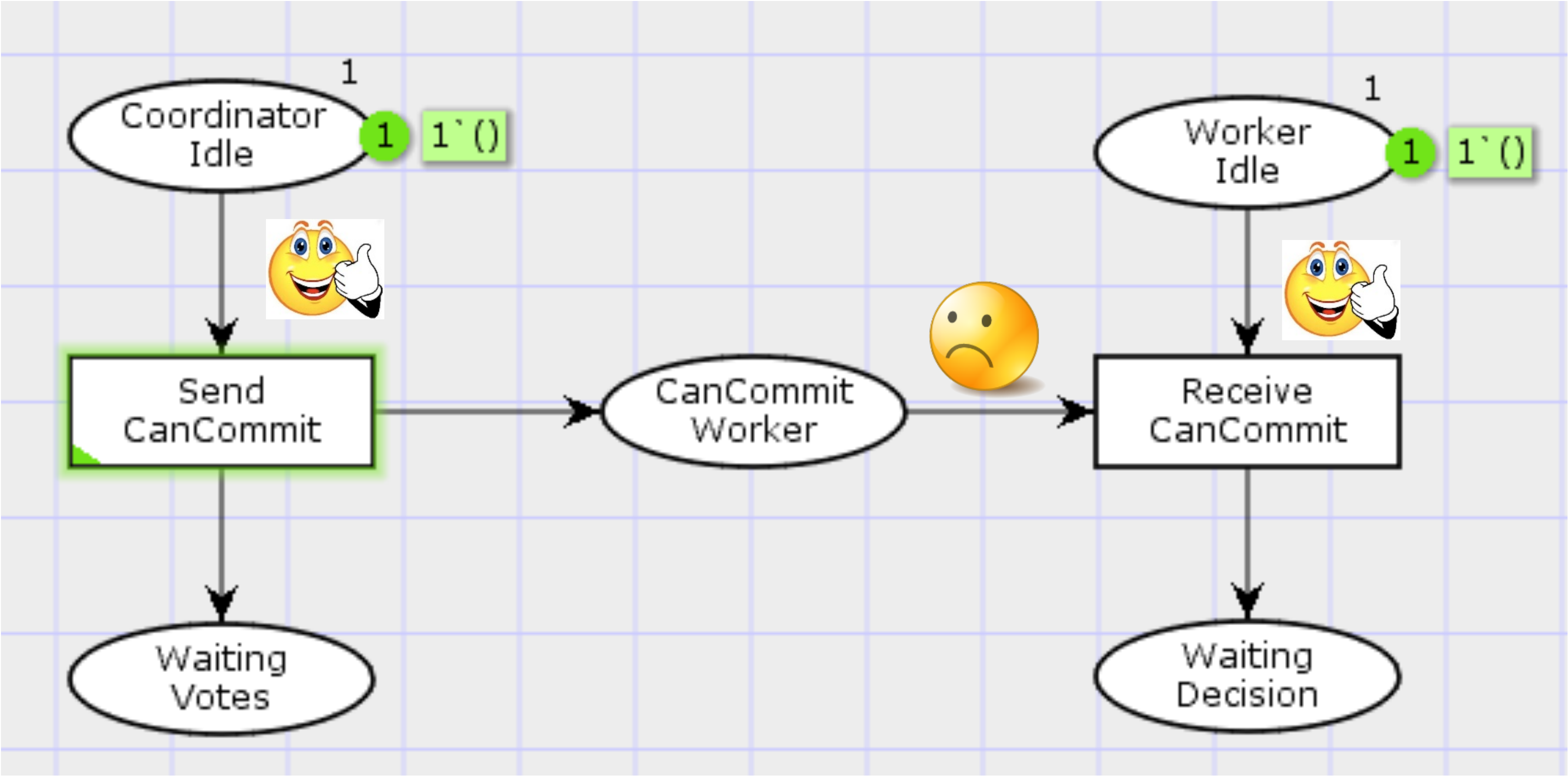
Arcs

- **Connects places and transitions and determine transition enabling and occurrence (firing):**



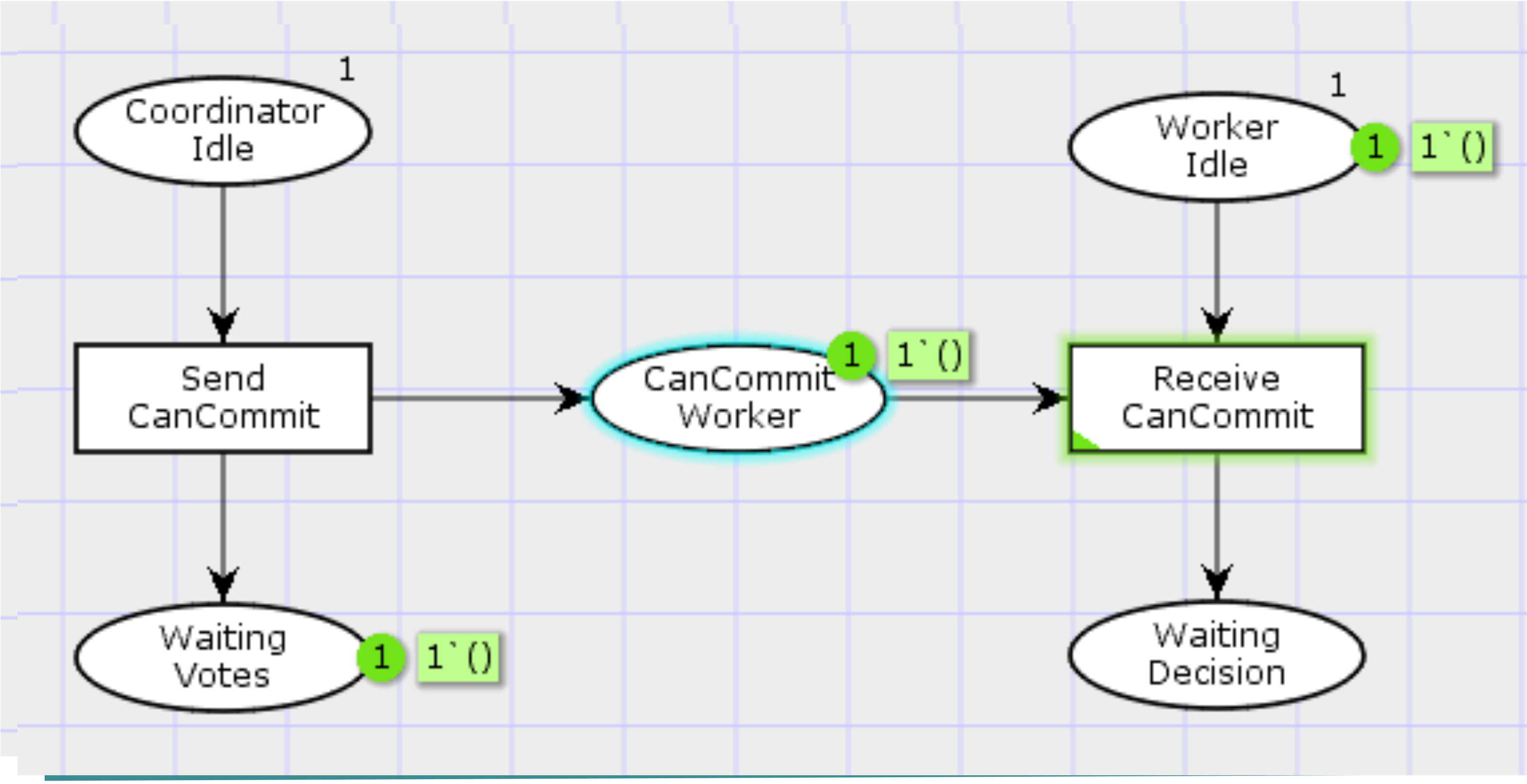
Transition Enabling

- A transition is **enabled** if there is at least one token on each of its input places



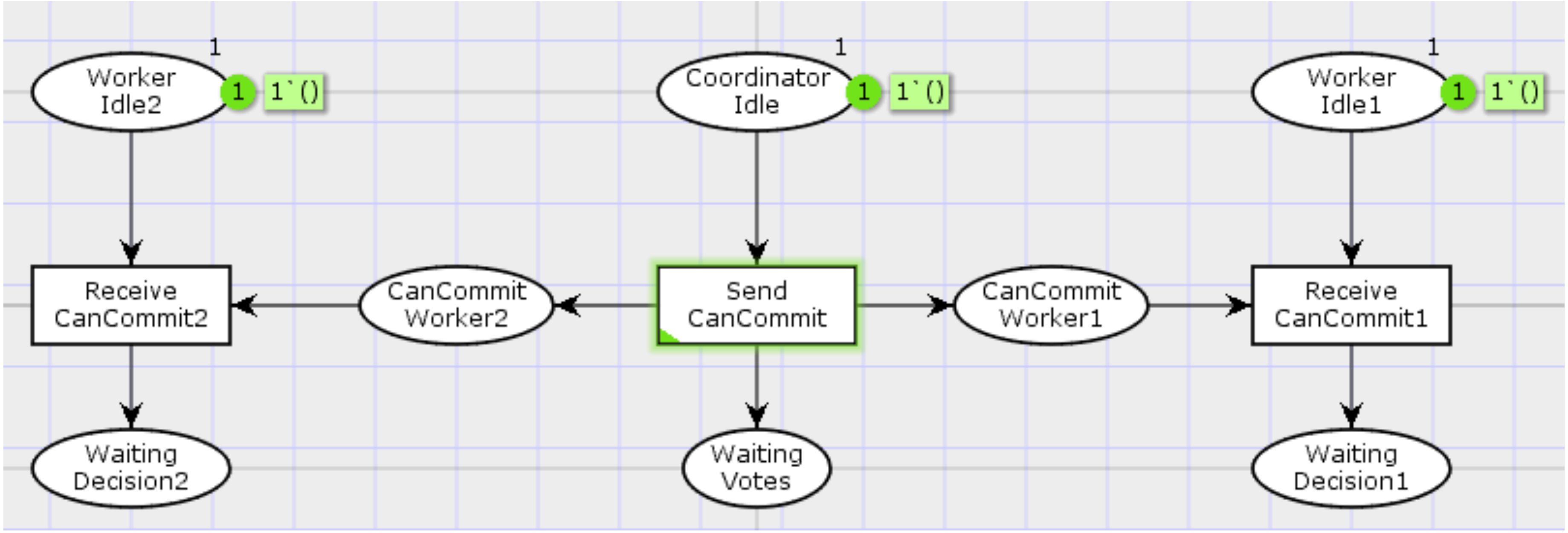
Transition Occurrence

- **An enabled transition may occur (fire):**
  - Removes one token from each input place
  - Adds one token to each output place



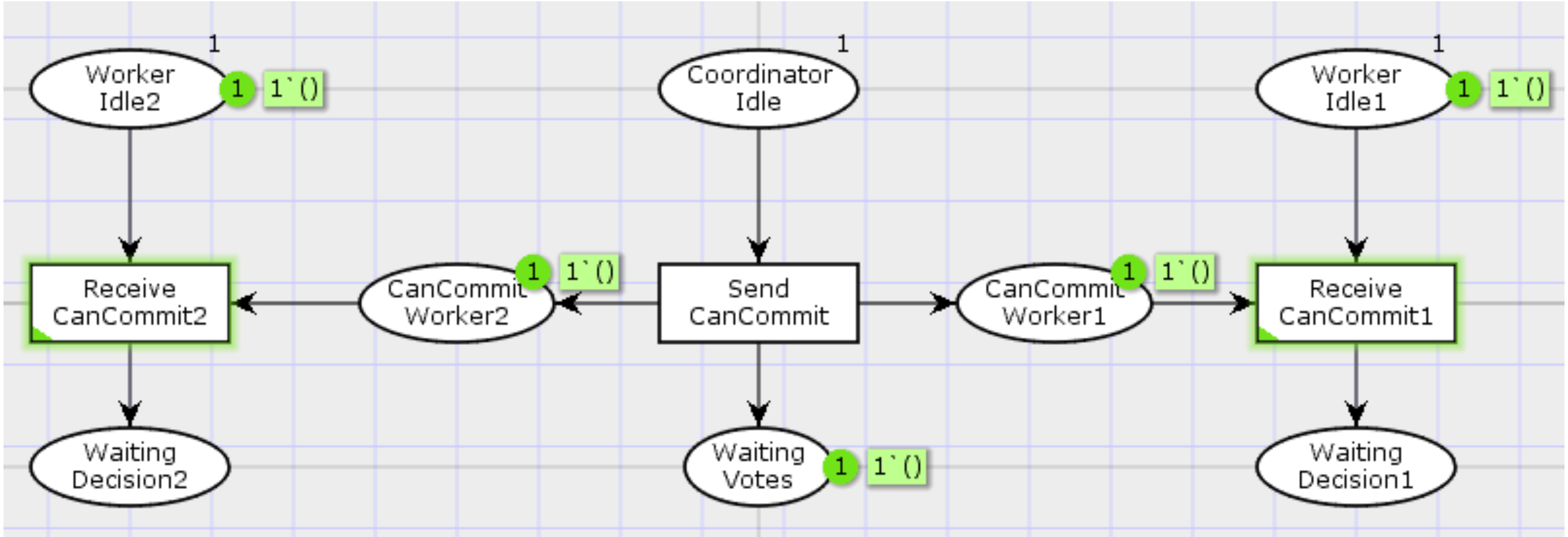
Multiple Workers

- **Extending the model to multiple workers**



Concurrency

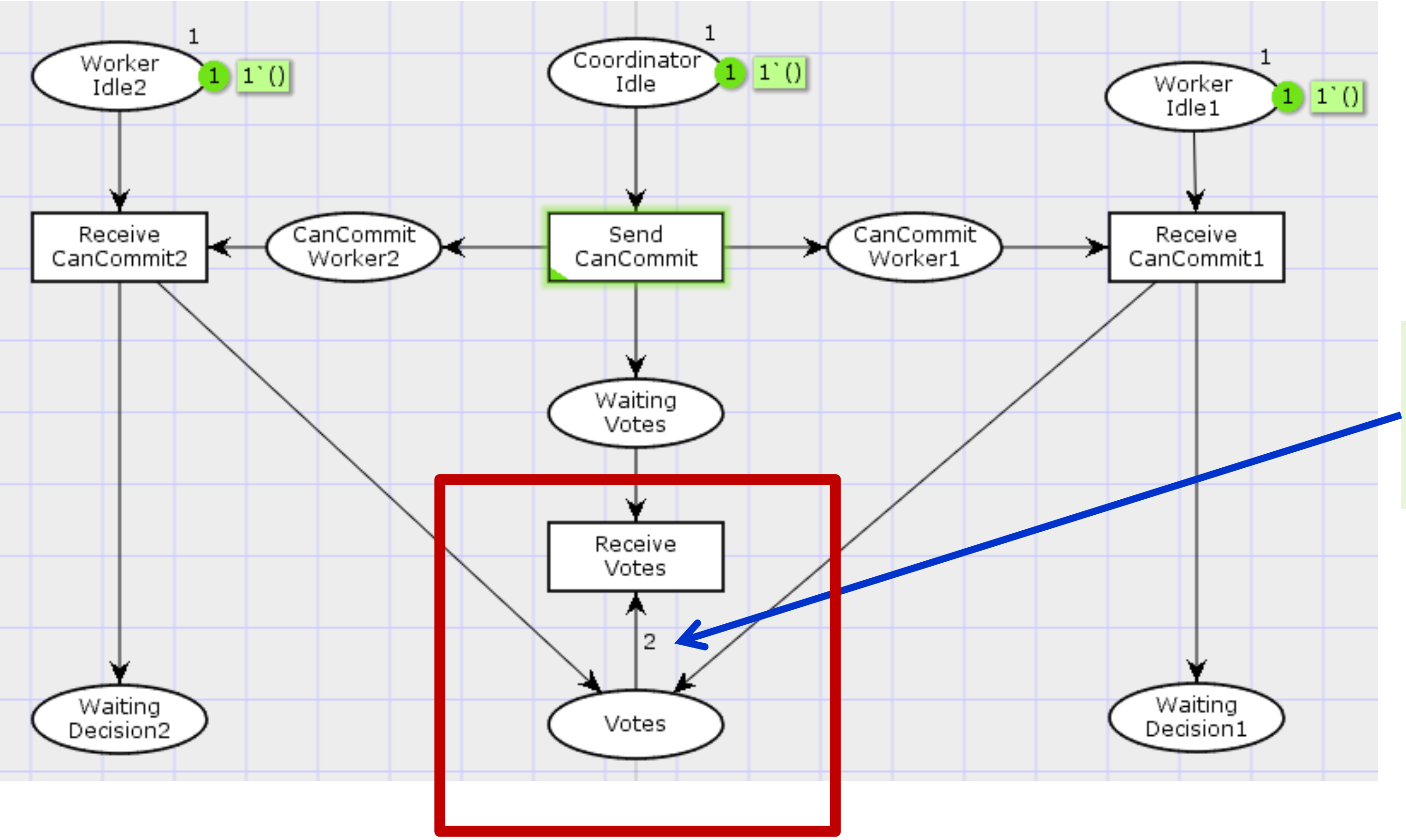
- Transitions may be concurrently enabled in the same simulation step



- Transitions are able to get the tokens required without sharing them with other transitions

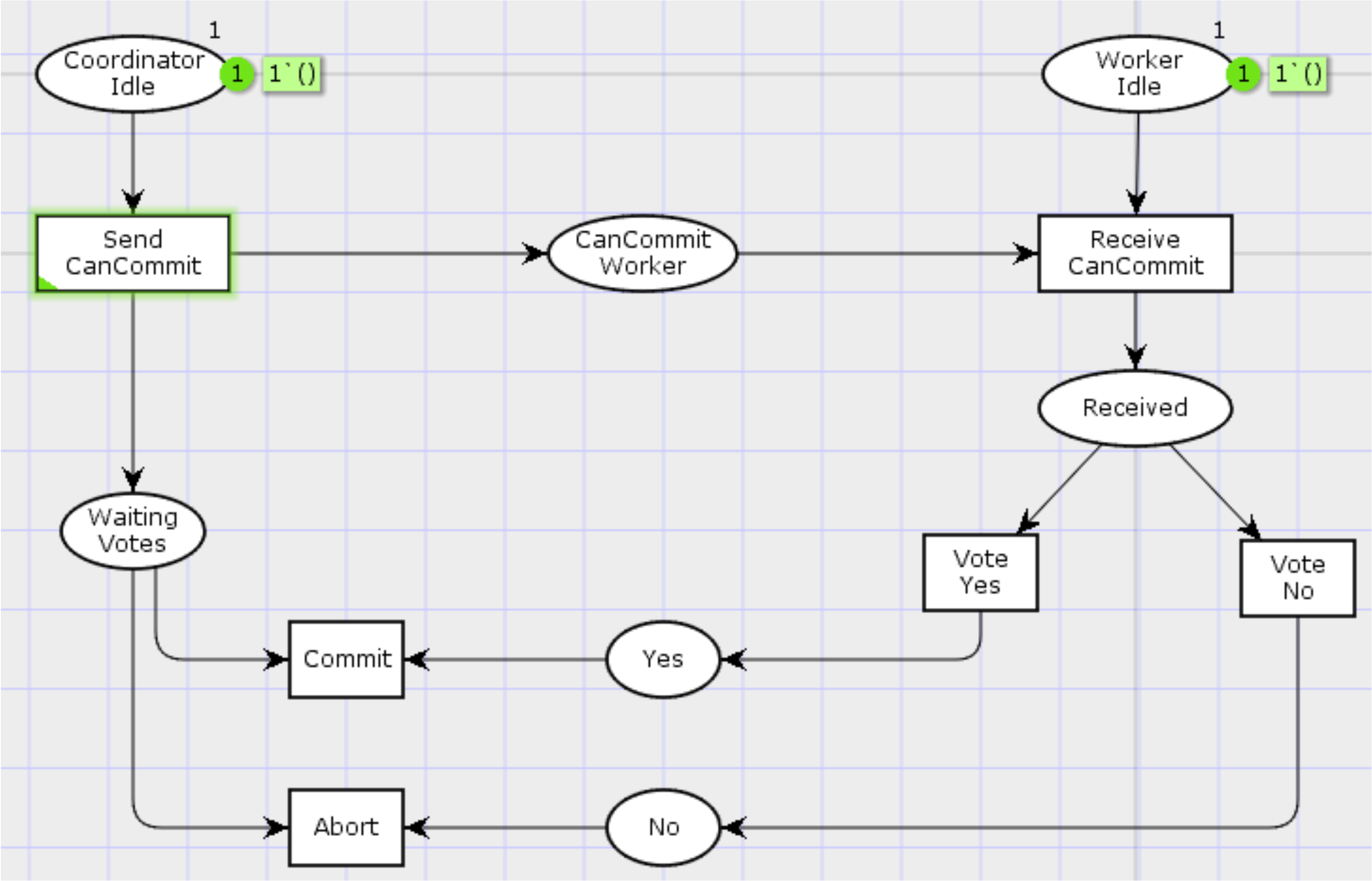
Arc Weights

- **Number of tokens required for enabling, consumed and produced (occurrence):**



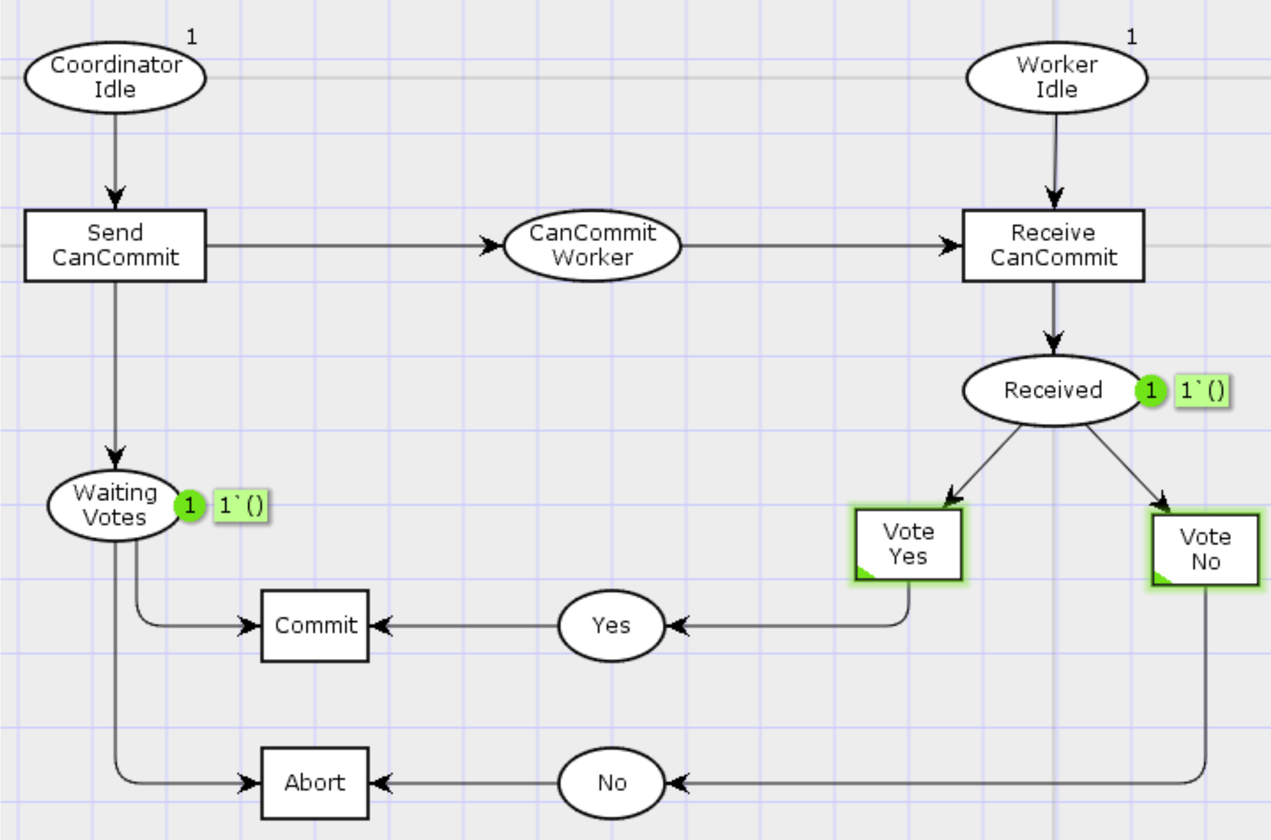
Both workers must have sent a reply

Modelling Votes



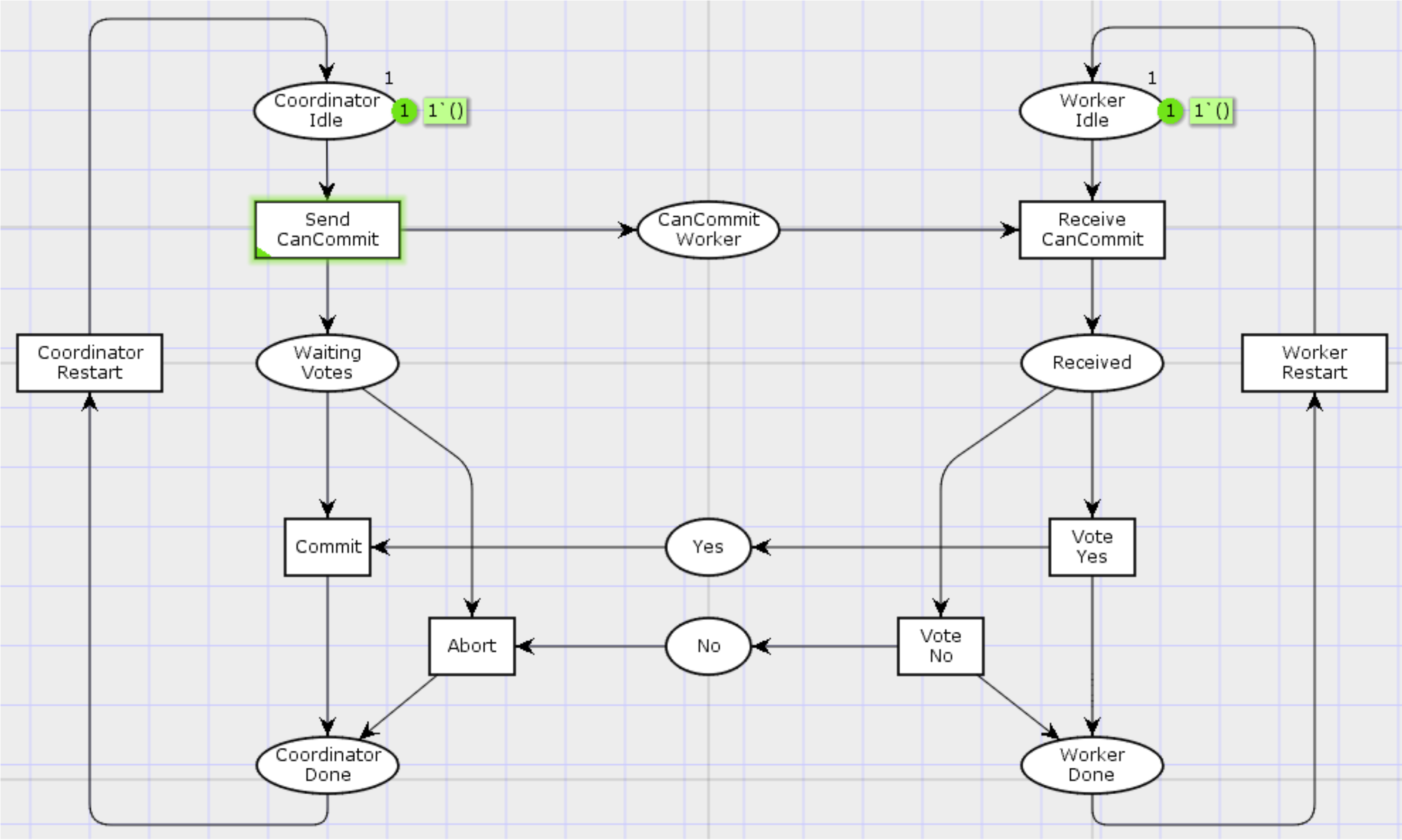
Conflict

- **Transitions are in conflict if they compete for tokens with other enabled transitions**



Reactive Systems

- **Many concurrency systems are based on executing an event-loop**



Summary

- **Basic syntactical and semantical concepts of Place/Transition Nets introduced.**
- **Additional constructs**
  - Inhibitor arcs and reset arcs
  - Transition priorities
- **A main limitation of Place/Transitions Nets is scalability of large (real) software systems**
  - Modelling of data is inconvenient.
  - Does not allow models to be split into modules
  - Does not support parametric systems in an elegant way