States

Introduction

- A state machine …
  - Models the behavior of an individual object (statechart diagram) or a society of objects (activity diagram).
  - Is a dynamic model of the system.
  - Is event driven.
    - Events trigger activities which, in turn, trigger actions.
    - Actions are atomic.
    - Actions may cause the return of a value or the change of state of an object.
  - State machines come in two varieties:
    - Activity diagrams.
    - Statechart diagrams.

Introduction

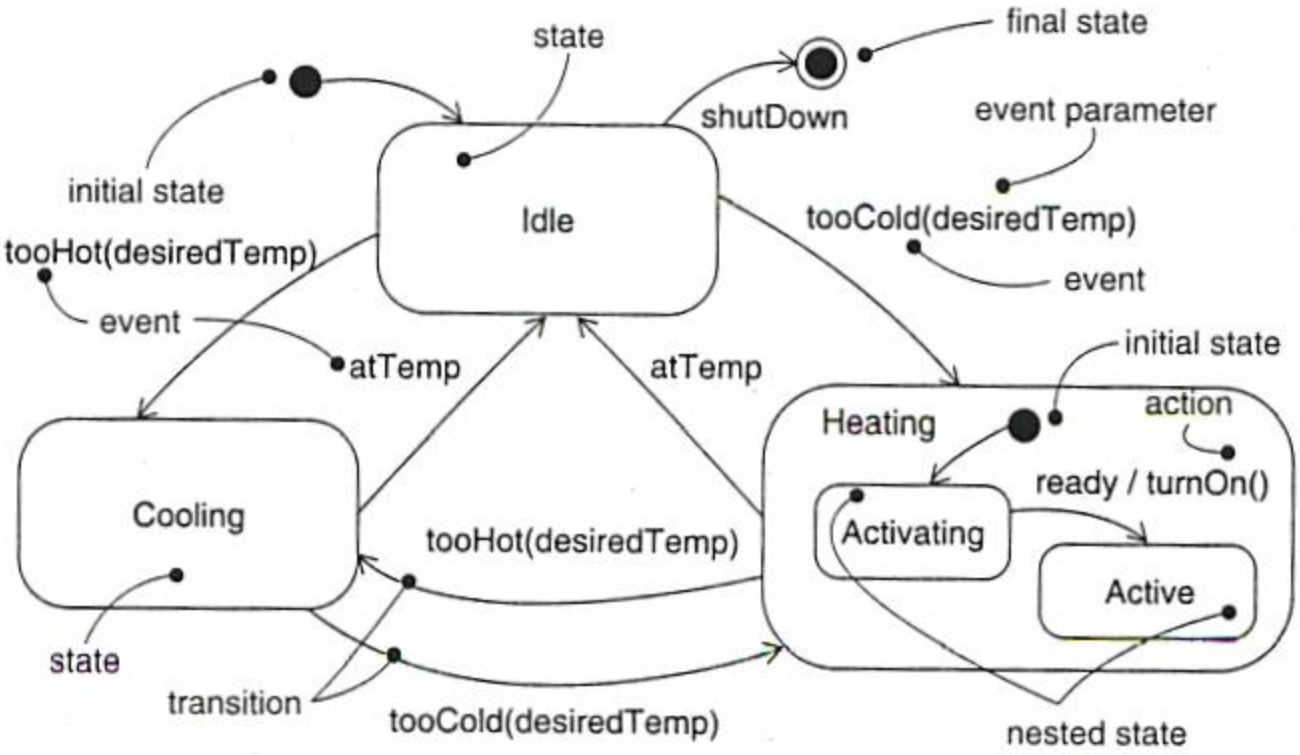


Figure 21-1: State Machines

Terms and Concepts

- States
  - A state is a condition or situation during the life of an object in which it satisfies some condition, performs some activity, or waits for some event.
  - A state may include …
    - Name
    - Entry/exit actions
    - Internal transitions
    - Activities
    - Substates - may sequential or concurrent
    - Deferred events (infrequently used)

Terms and Concepts

- States
  - Special categories of states
    - Initial state - indicates the initial starting state for for the state machine or a substate.
    - Final state - indicates the state machine's execution has completed.
      - Real-time state machines frequently do not include a final state.
    - Neither initial or final states contain any of the parts found in traditional states.

Terms and Concepts

As Figure 21-2 shows, you represent a state as a rectangle with rounded corners.

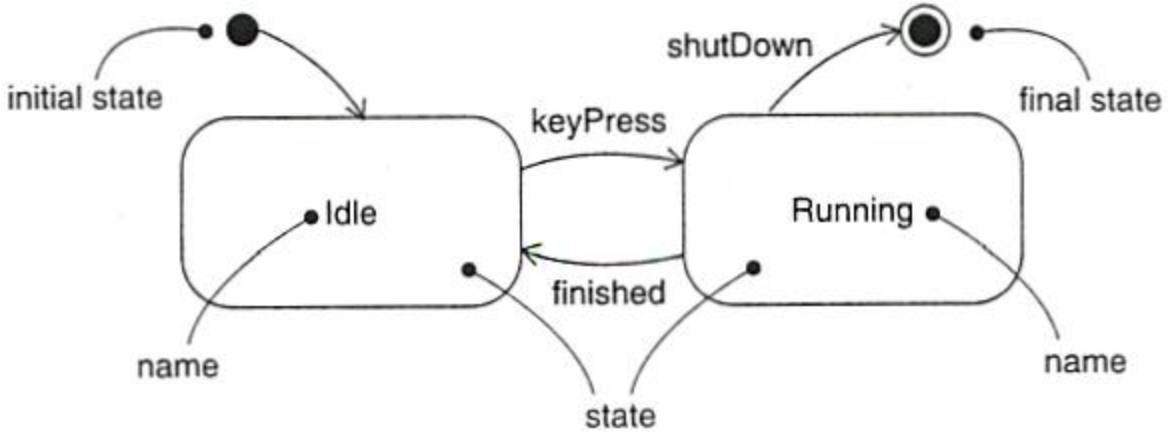


Figure 21-2: States

Terms and Concepts

- Transition
  - A directed relationship between two states.
  - A flow of control through a statechart diagram.
  - Contains five parts
    - Source state - current state before transition fires.
    - Event trigger - external stimulus that has the potential to cause a transition to fire.
    - Guard condition - a condition that must be satisfied before a transition can fire.
    - Action - an executable atomic computation.
    - Target state - new state after transition fires.

Terms and Concepts

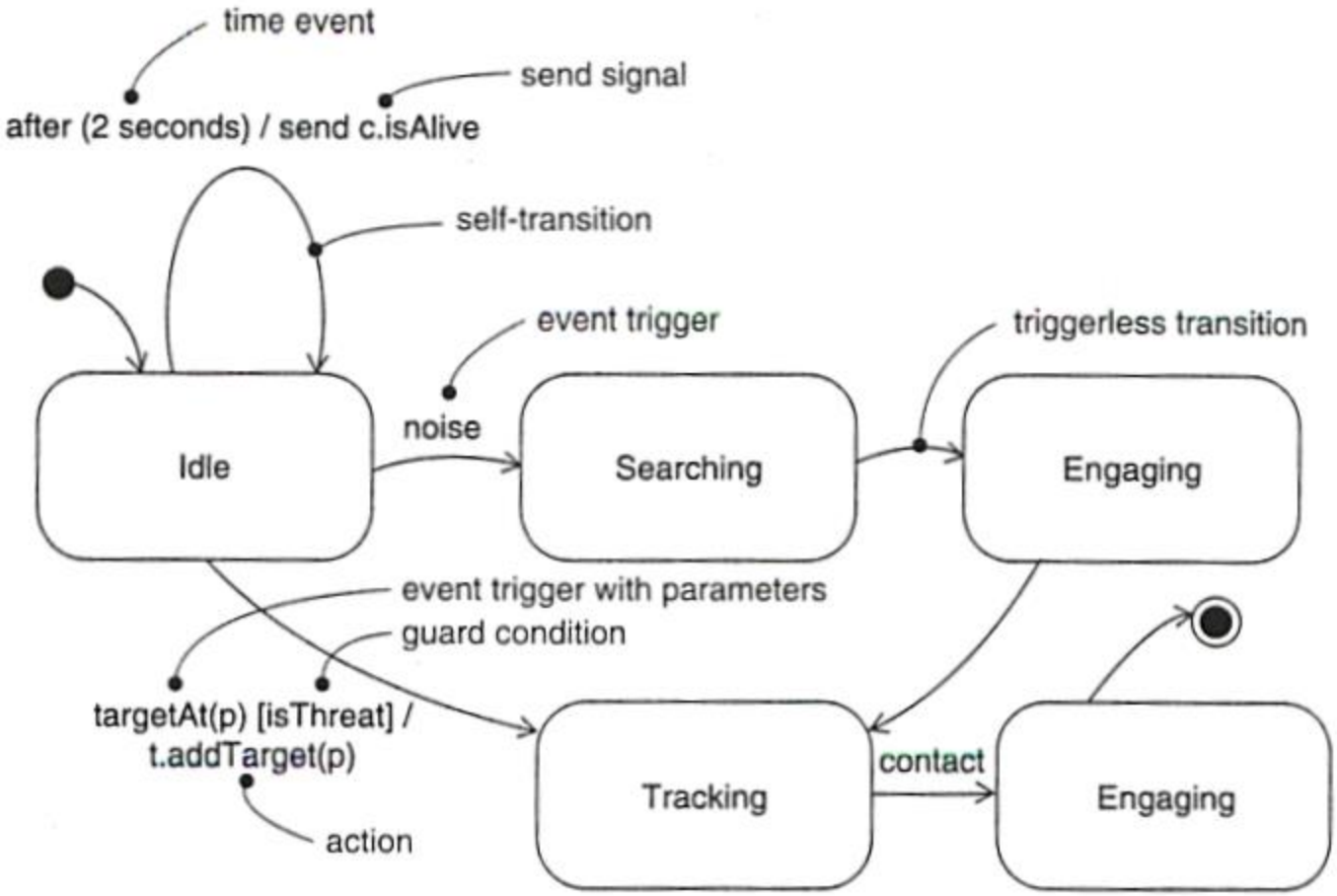


Figure 21-3: Transitions

Terms and Concepts

- Advanced States and Transitions
  - Entry action - Upon each entry to a state, a specified action is automatically executed.
    - Syntax (to be placed inside the state symbol):
      entry / action
  - Exit action - Just prior to leaving a state, a specified action is automatically executed.
    - Syntax (to be placed inside the state symbol):
      exit / action

Terms and Concepts

- Advanced States and Transitions
  - Internal Transitions - The handling of an event without leaving the current state.
    - Used to avoid a states entry and exit actions.
    - Syntax (to be placed inside the state symbol):
      event / action
  - Activities - Ongoing work that an object performs while in a particular state. The work automatically terminates when the state is exited.
    - Syntax (to be placed inside the state symbol):
      do / activity
    - Activities are ongoing operations; actions are instantaneous operations.

Terms and Concepts

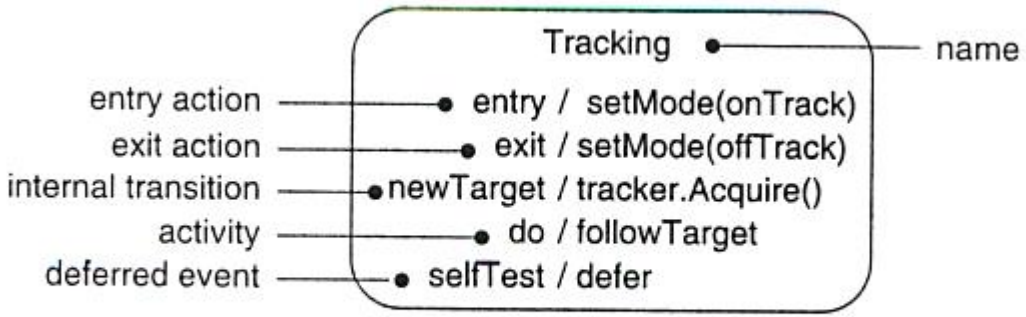


Figure 21-4: Advanced States and Transitions

Terms and Concepts

- Advanced States and Transitions
  - Deferred Event - An event whose occurrence is responded to at a later time.
    - Syntax (to be placed inside the state symbol):
      event / defer
    - Once an event has been deferred it remains deferred until a state is entered where that particular type of event is not listed as deferred. The state diagram then responds to the event as if it had just occurred.

Terms and Concepts

- Advanced States and Transitions
  - Simple state - A state that contains no *substates*.
  - Composite state - A state that contains *substates*.
  - Substate - A state that is nested inside another state.
    - Substates allow state diagrams to show different levels of abstraction.
    - Substates may be sequential or concurrent.
    - Substates may be nested to any level.

Terms and Concepts

- Advanced States and Transitions
  - Sequential Substates - The most common type of substate. Essentially, a state diagram within a single state.
    - The "containing" state becomes an abstract state.
    - The use of substates simplifies state diagrams by reducing the number of transition lines.
    - A nested sequential state diagram may have at most one initial state and one final state.

Terms and Concepts

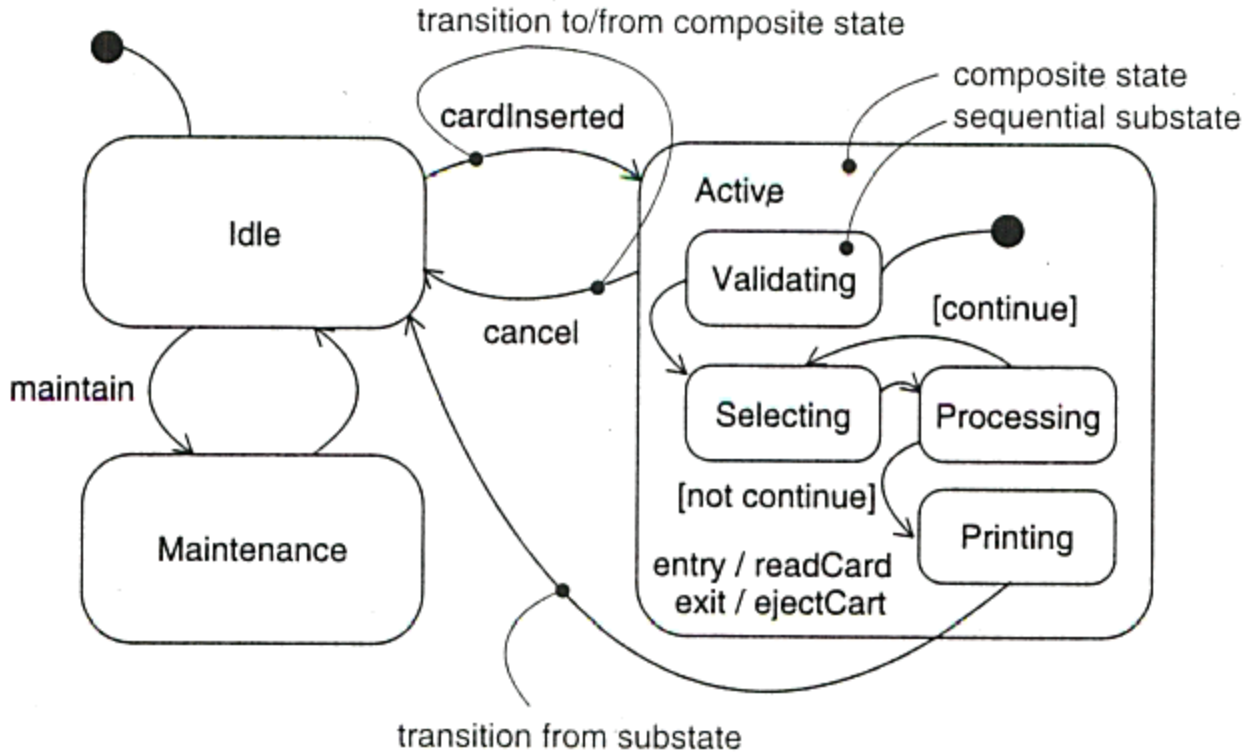


Figure 21-5: Sequential Substates

Terms and Concepts

- Advanced States and Transitions
  - History States - Allows an object to remember which substate was last active when the containing state was exited.
    - Upon re-entry to the containing state, the substate that was last active will be re-entered directly.

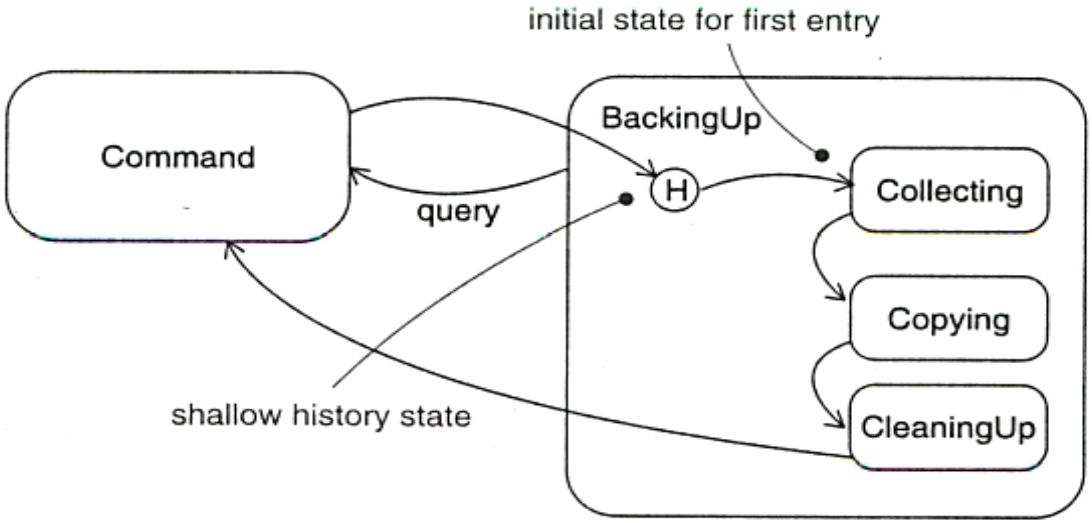


Figure 21-6: History State

Terms and Concepts

- Advanced States and Transitions
  - Concurrent Substates - Used when two or more state diagrams are executing concurrently within a single object.
    - Allows an object to be in multiple states simultaneously.
    - The concurrent state diagrams within a "containing" state must begin and end execution simultaneously.
    - If one concurrent state diagram finishes first, it must wait for the others to complete before exiting the containing state.

Terms and Concepts

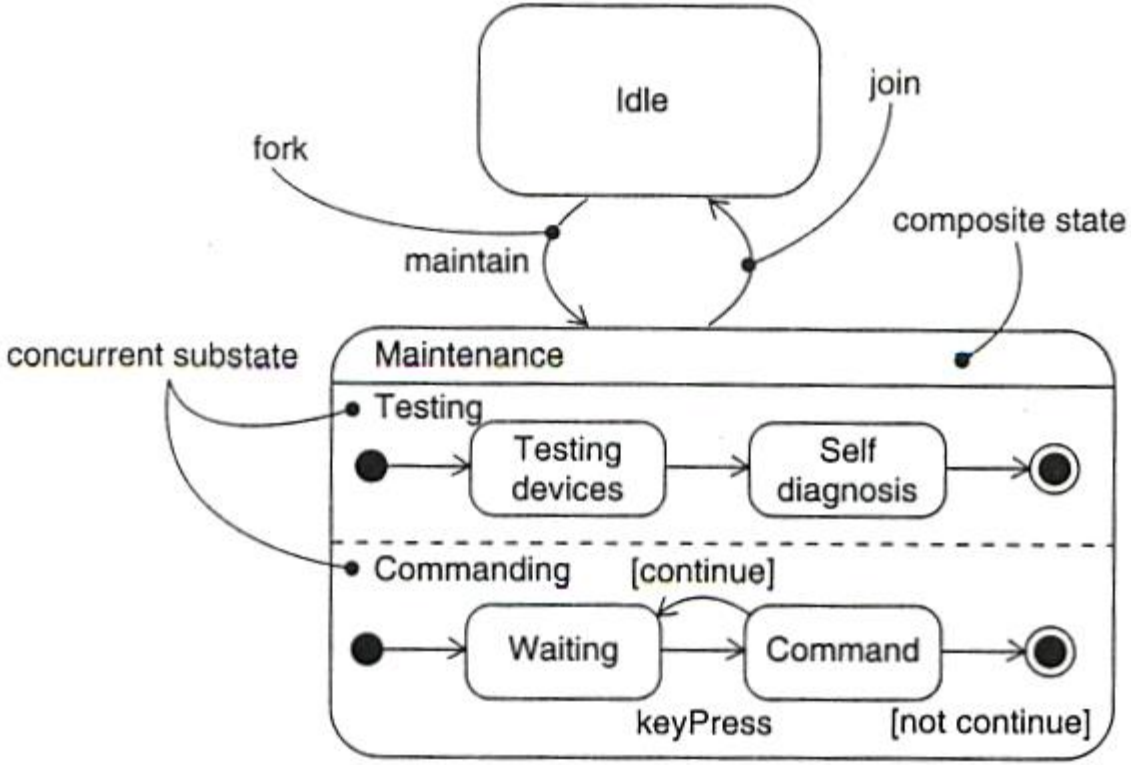
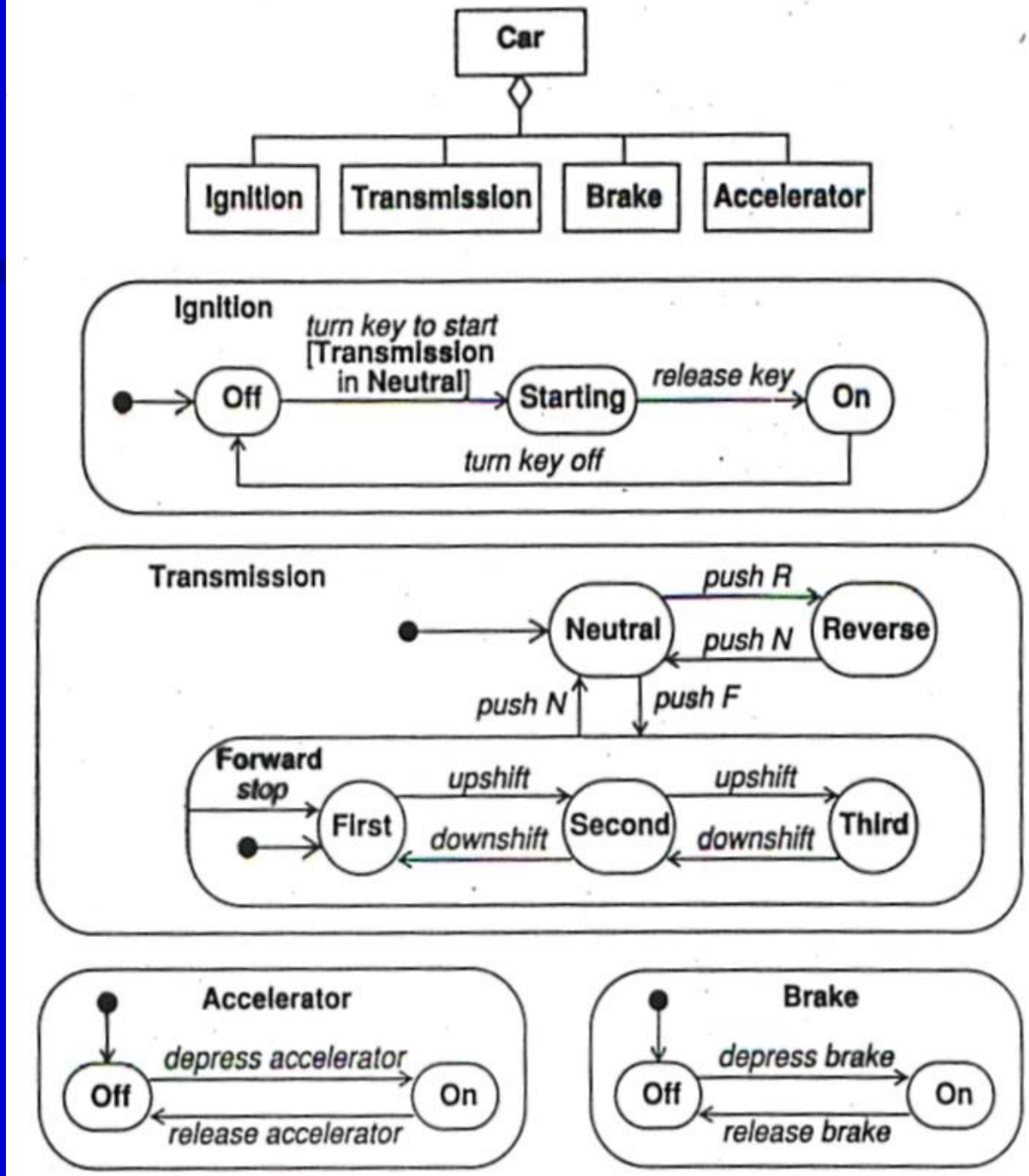


Figure 21-7: Concurrent Substates

Concurrent State Diagrams Using OMT Notation



State Diagram for a Phone Line

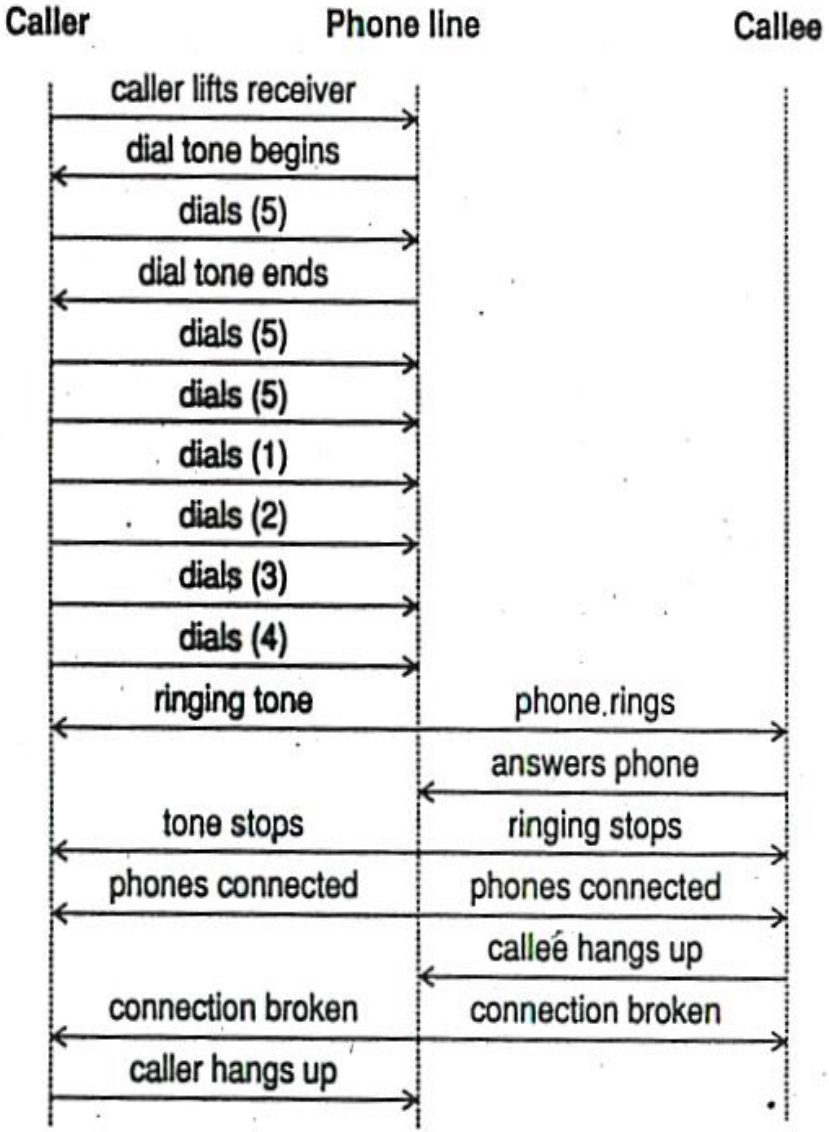


Figure 5.3 Event trace for phone call

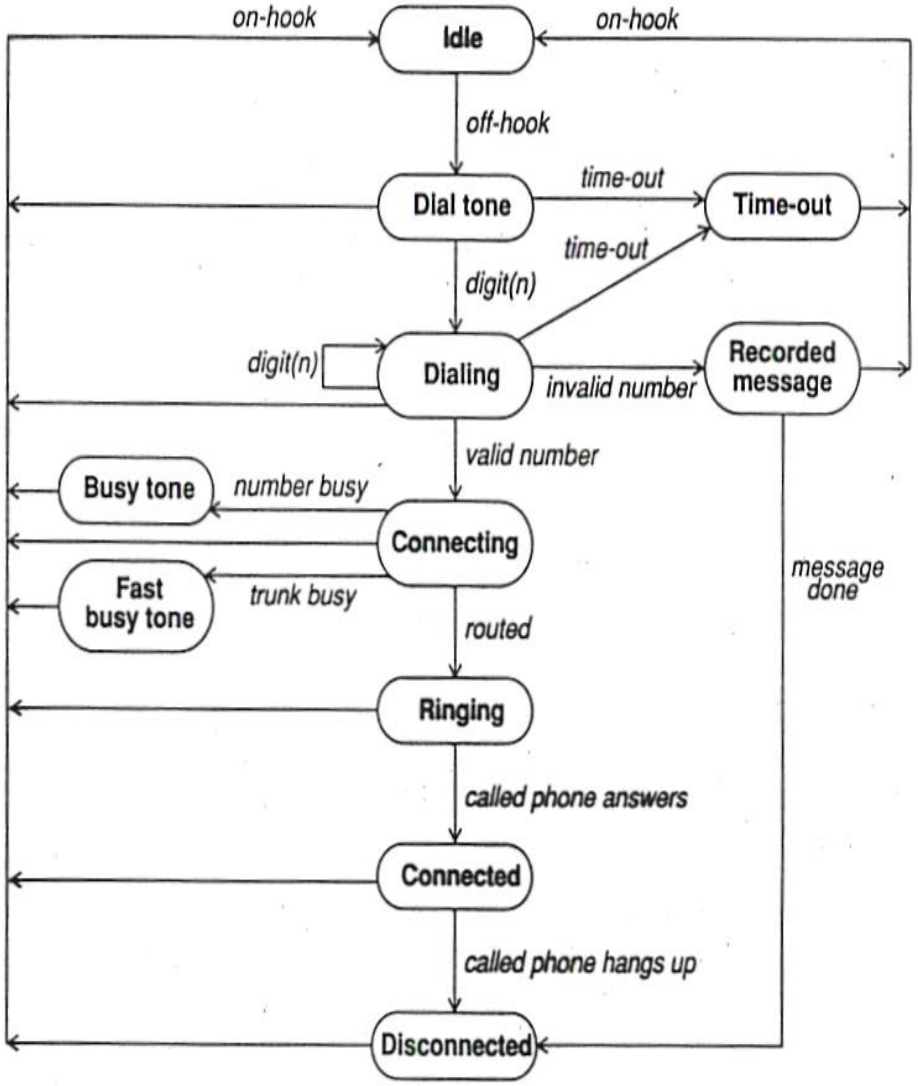
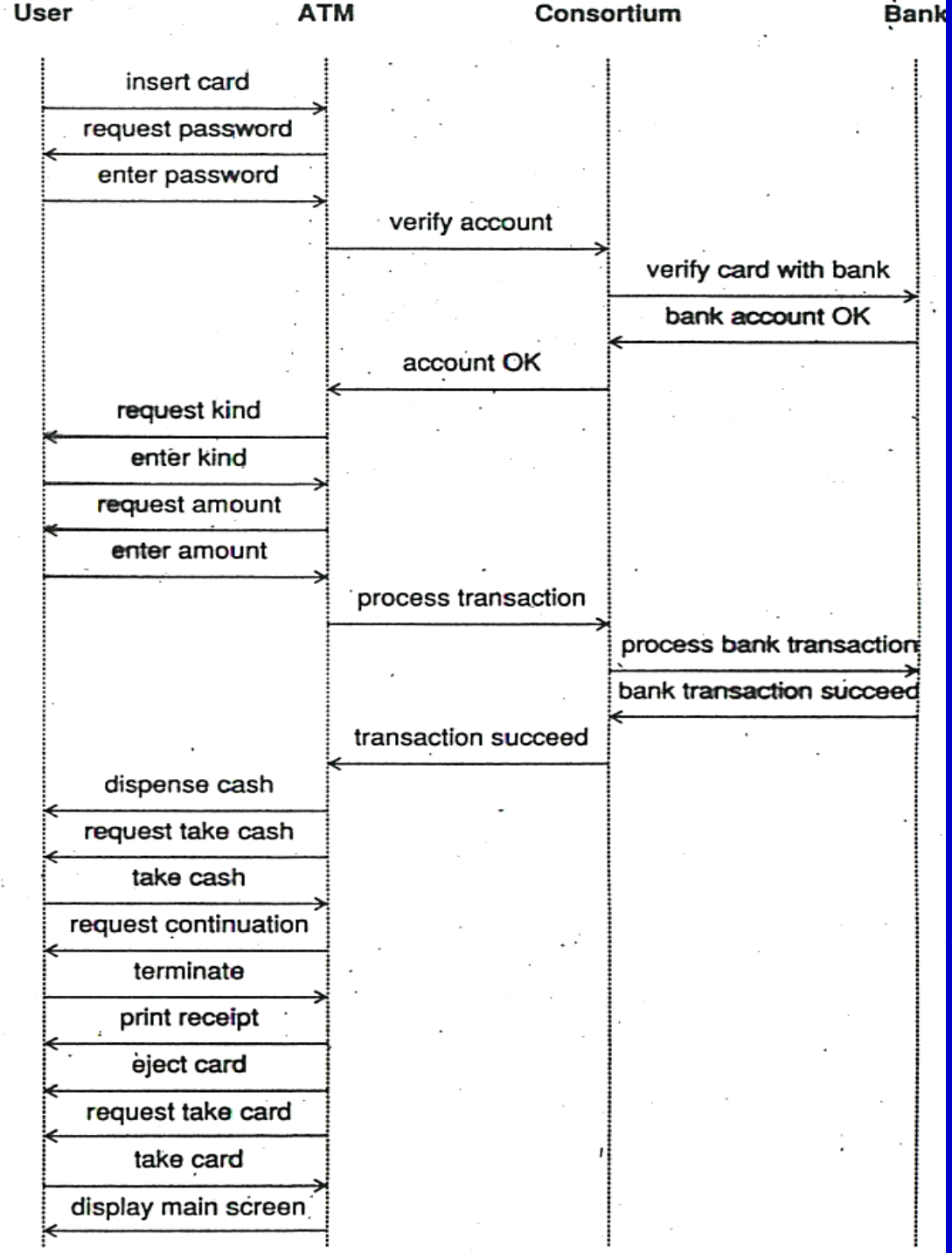


Figure 5.5 State diagram for phone line



Event Trace for an ATM Transaction

State Diagrams ATM, Bank, and Consortium

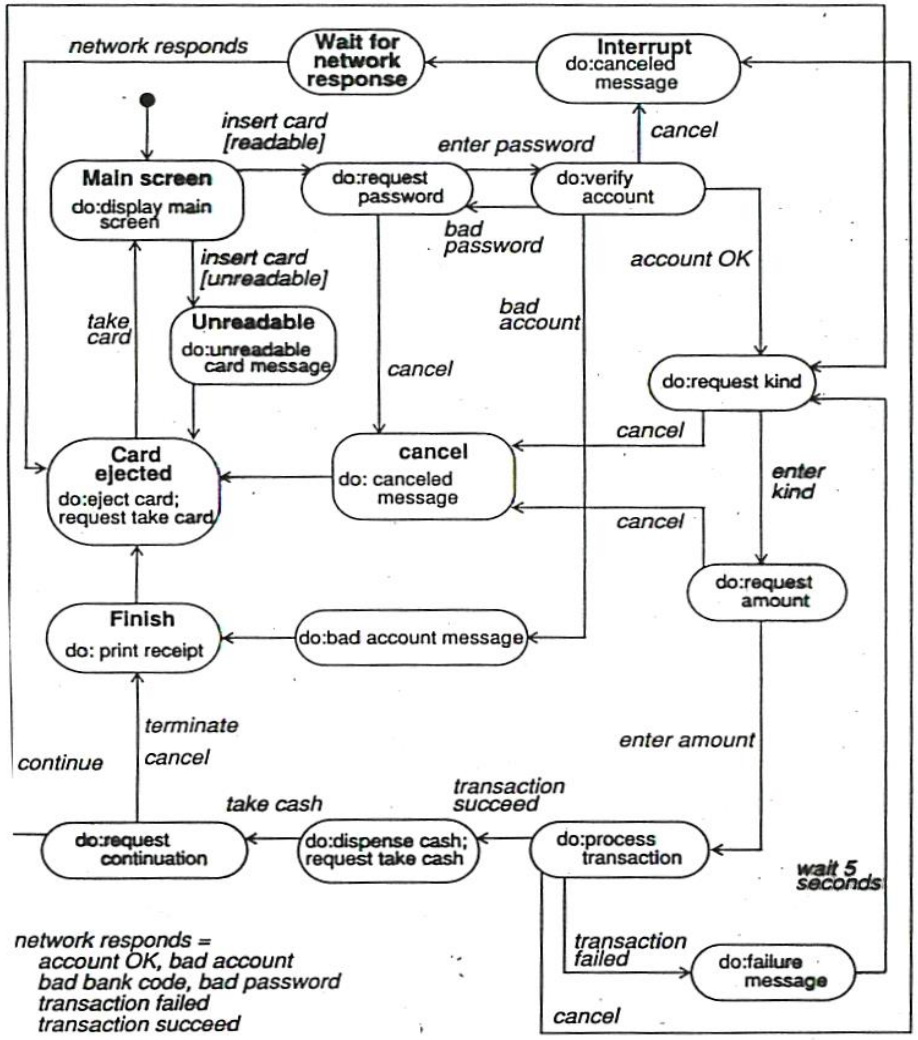


Figure 8.20 State diagram for class *ATM*

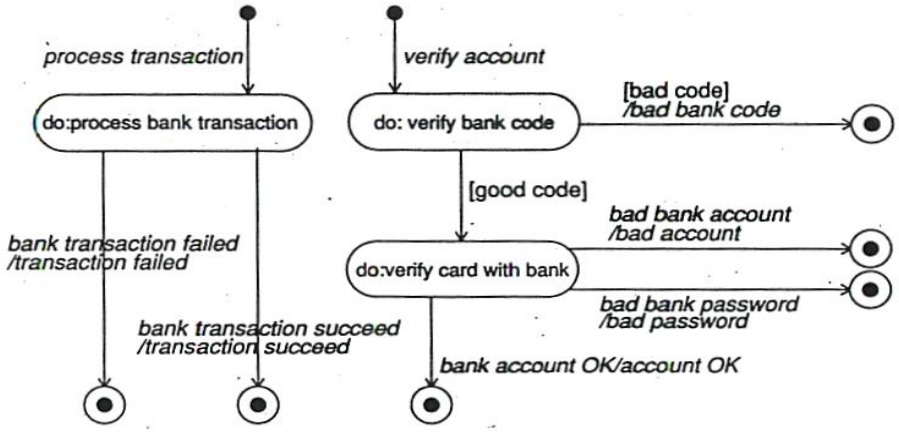


Figure 8.21 State diagram for class *Consortium*

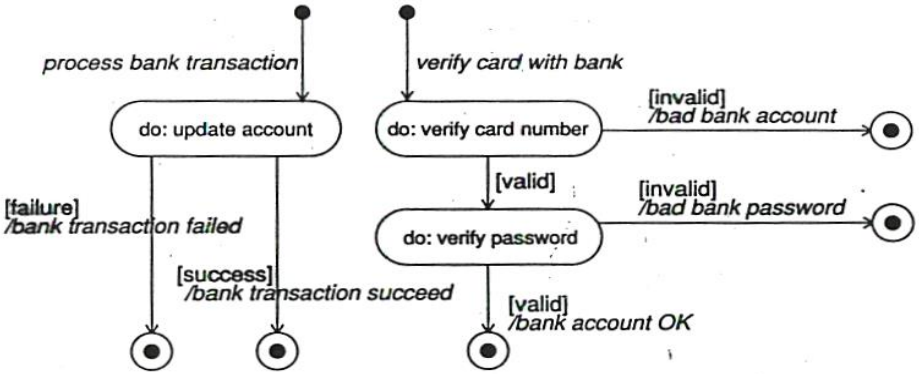


Figure 8.22 State diagram for class *Bank*

Statechart Diagrams

Introduction

- A statechart diagram, also known as state diagram, models the dynamic aspects of the system by showing the flow of control from state to state for a particular class.
- Every class will have its own statechart diagram.
  - In practice, only classes with interesting or complex internal behavior will be modeled with statechart diagrams.
  - Statechart diagrams are not shared among classes.

Introduction

- Whereas an activity diagram models the flow of control from activity to activity, a statechart diagram models the flow of control from event to event.
- Statechart diagrams show how an object reacts to external events or conditions during the course of its lifetime.

Terms and Concepts

- State
  - A state is a condition or situation during the life of an object in which it satisfies some condition, performs some activity, or waits for some event.
- Transition
  - A transition is a relationship between two states indicating that an object in the first state will perform certain actions and enter the second state when certain events and conditions have occurred.

Terms and Concepts

- Event
  - An event is the specification of a significant occurrence that has a location in time and space.
- Activity
  - An activity is an ongoing non-atomic execution within a state machine.
- Action
  - An action is an atomic execution within a state machine that results in a change of state or the return of a value.

Terms and Concepts

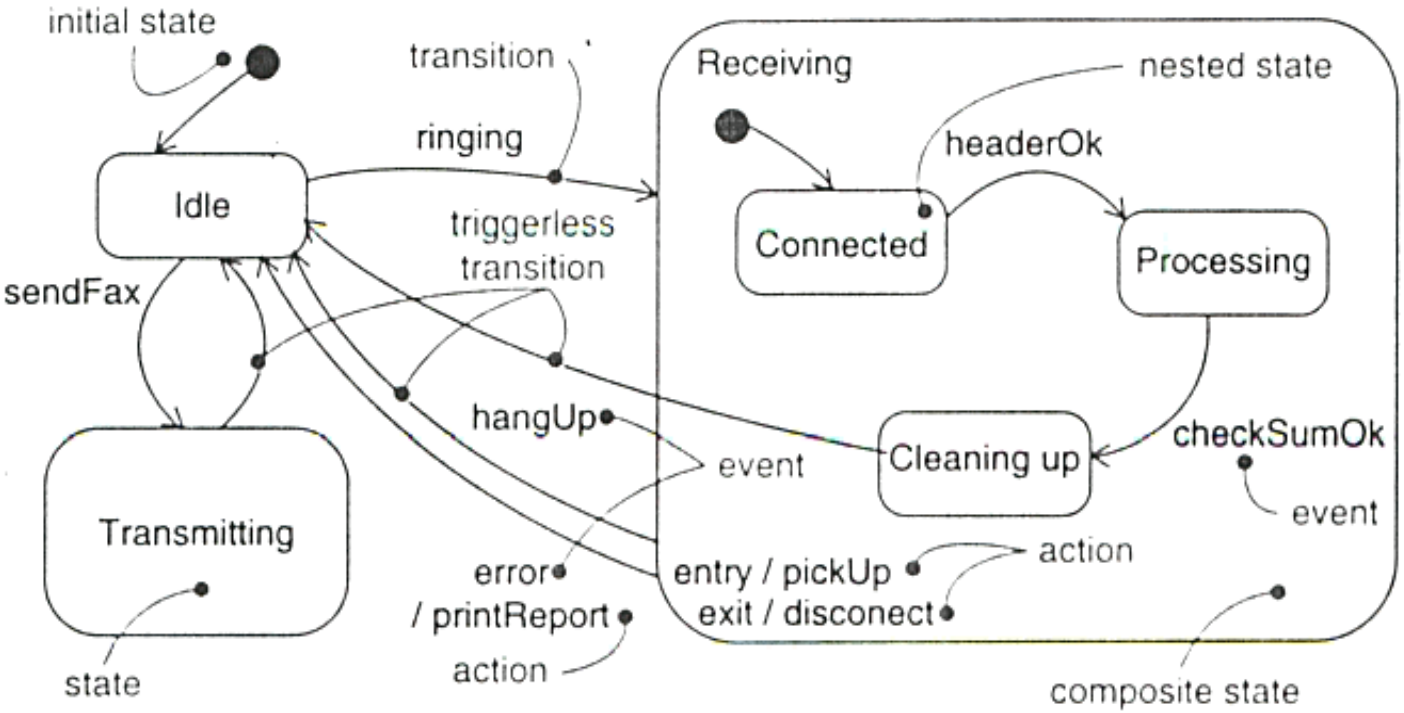


Figure 24-1: Statechart Diagram