Software Engineering

UML Diagrams in the Process

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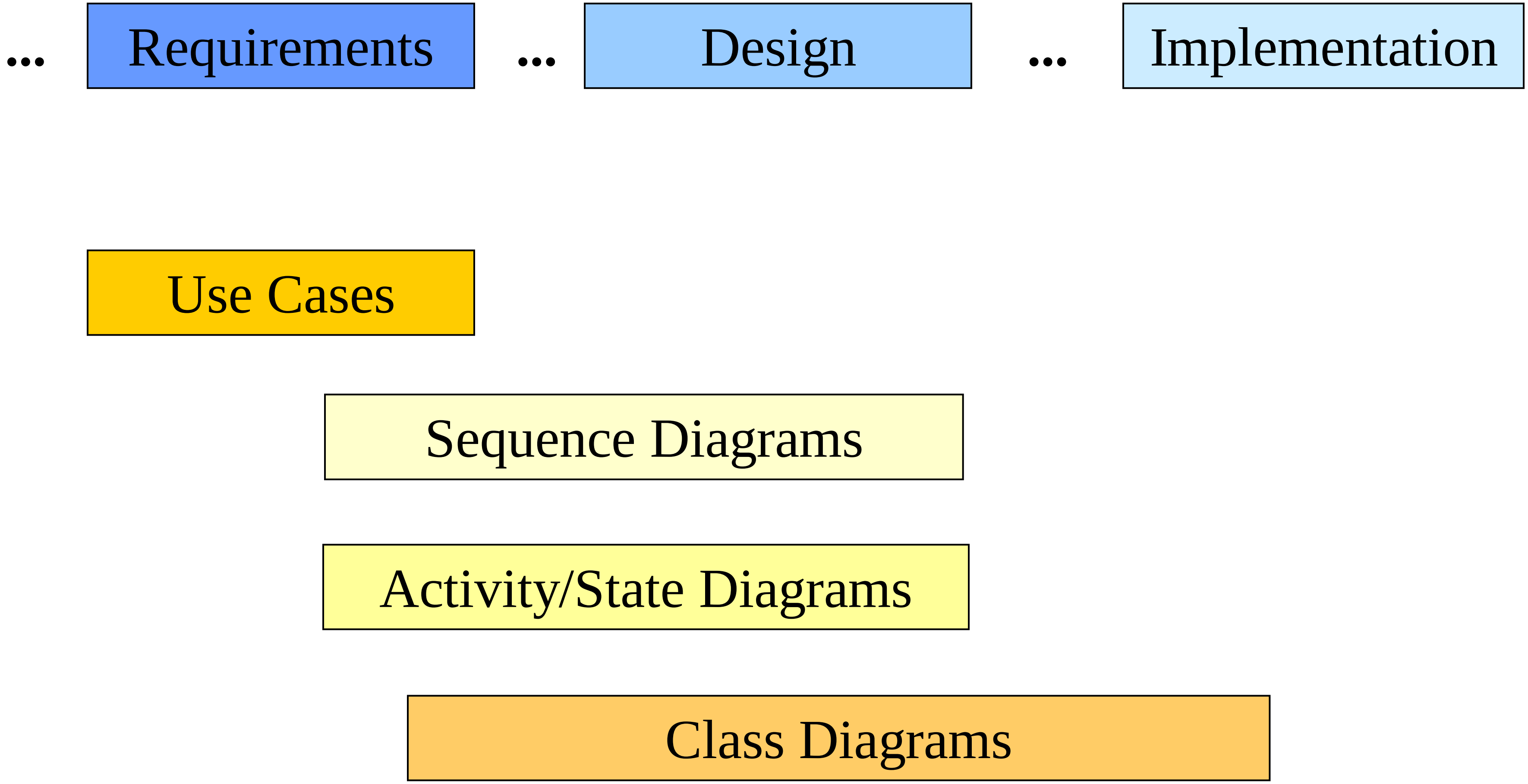

… Requirements … Design … Implementation

Use Cases

Sequence Diagrams

Activity/State Diagrams

Class Diagrams

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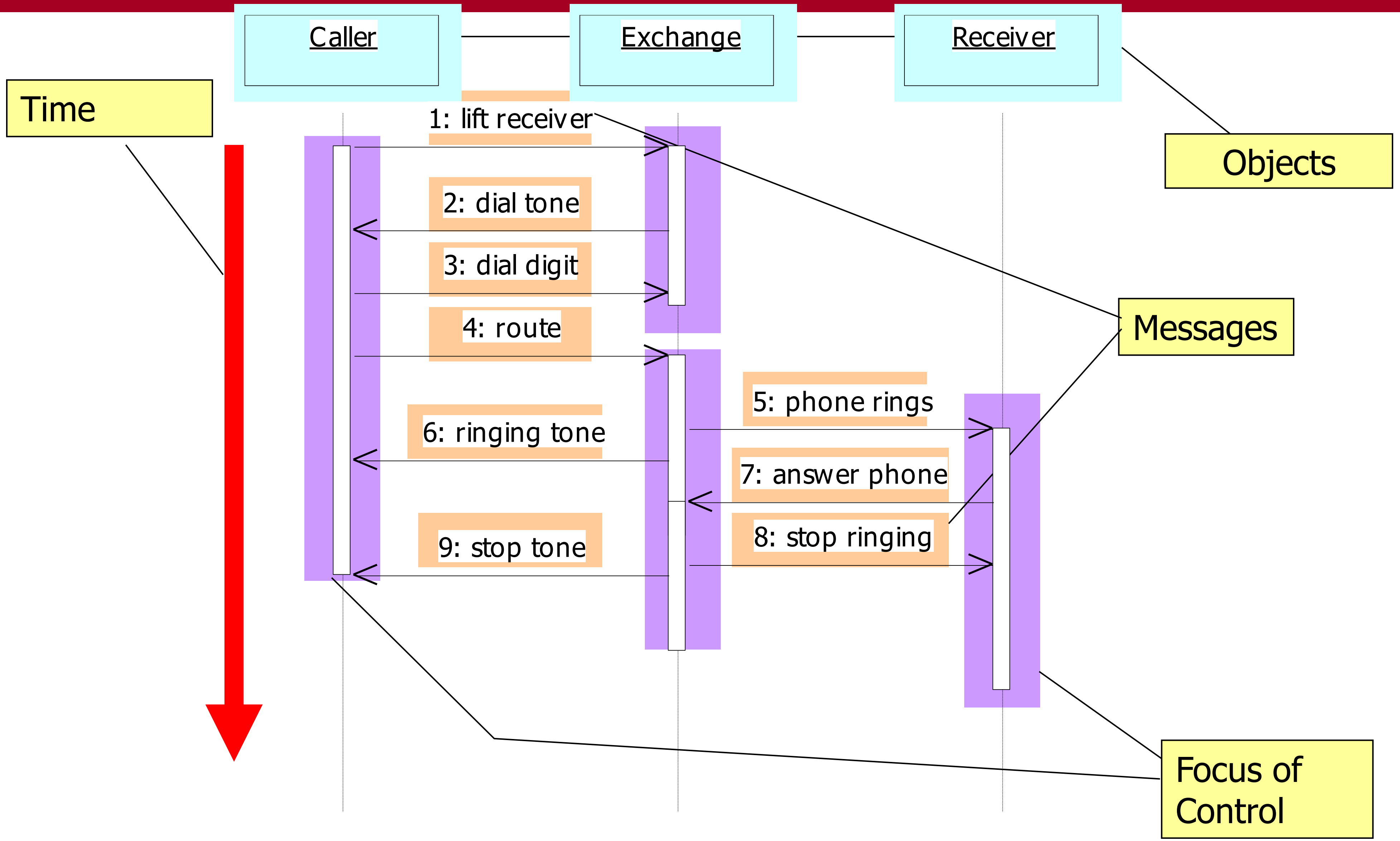
Sequence Diagrams

Sequence Diagrams: Motivations

- Use Case Diagrams present an outside view of the system
- Sequence Diagrams are good at representing how objects collaborate.

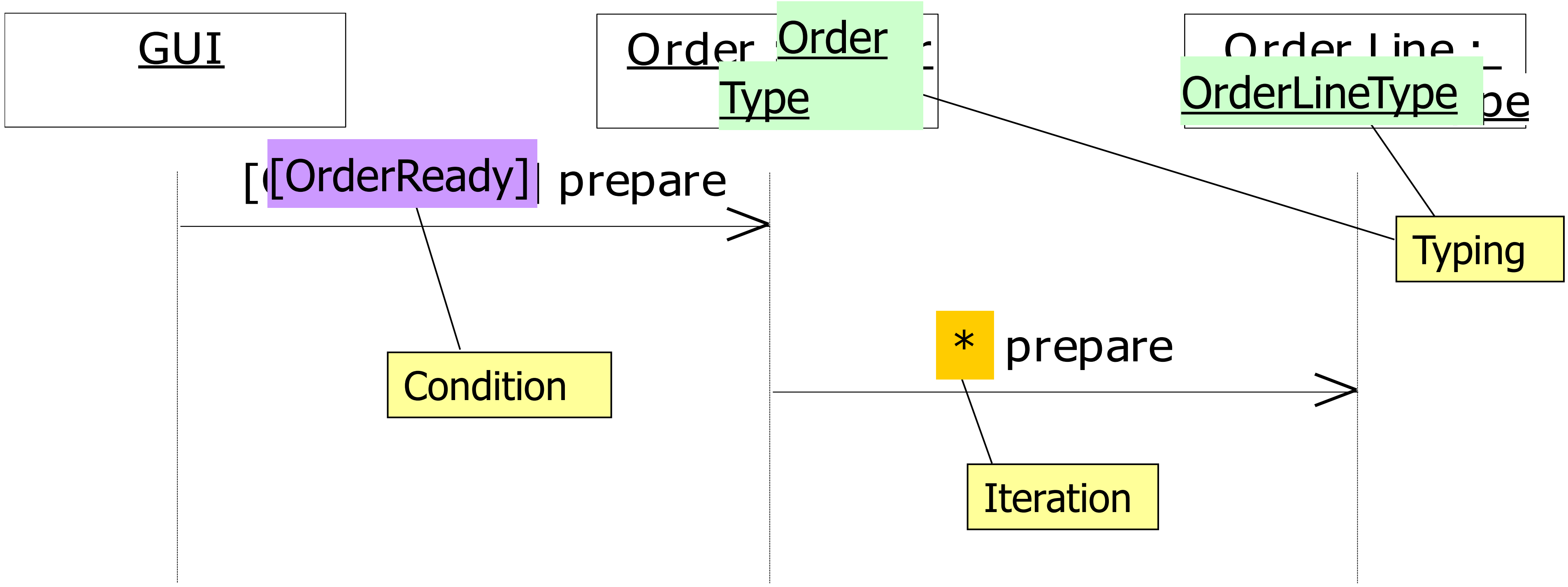
Sequence Diagram: Example



Sequence Diagrams: Ingredients

- Time: either unspecified or in fixed units
- Messages: a communication between two objects that conveys information with expectation that action will ensue
- Focus of Control: period during which an object is performing an action either directly or through a subordinate procedure.

Sequence Diagrams: More Concepts



GUI

Order Order Type

Order Line : OrderLineType

[OrderReady] prepare

Condition

Typing

* prepare

Iteration

Sequence Diagrams: More Concepts

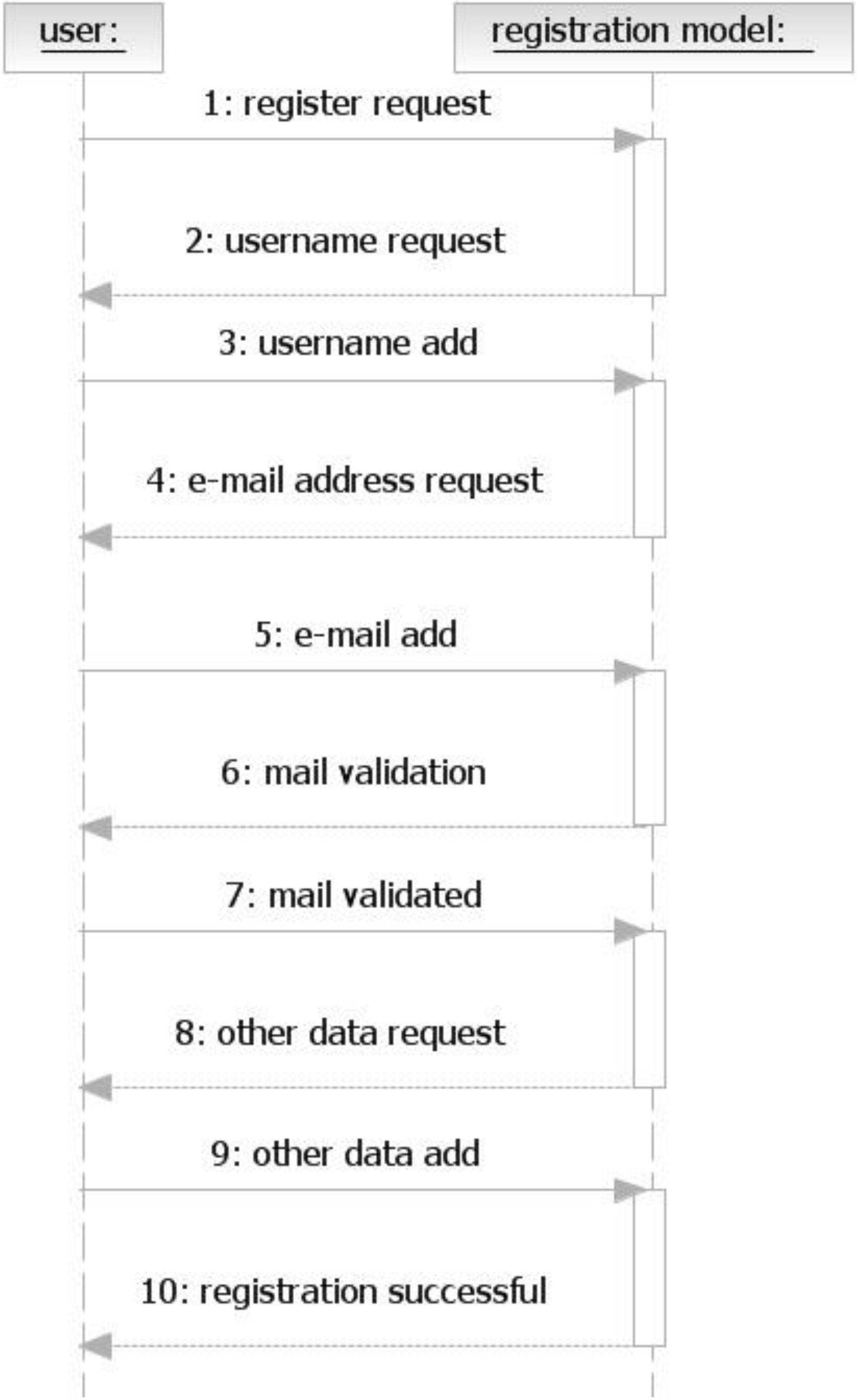
- Typing: define the types of objects
- Condition: define when a message is sent
- Iteration: message sent to all the instances of an object

- Focus Of Control: is optional!
- Message Numbering: is optional!

Sequence Diagrams vs. Use Case Diag.

Objects	Actors
Messages	Actions / Use Cases

Sequence Diagram of a registration



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State Machine and Activity Diagrams

Introduction

Quite often during both the specification and the development process you will be faced with the necessity of representing dynamic behaviors

Examples:

- Modeling workflows
- Modeling complex use cases
- Modeling lifecycle of objects

UML provides various diagrams for modeling dynamic behaviors, among which

- State Machine diagram
- Activity diagram

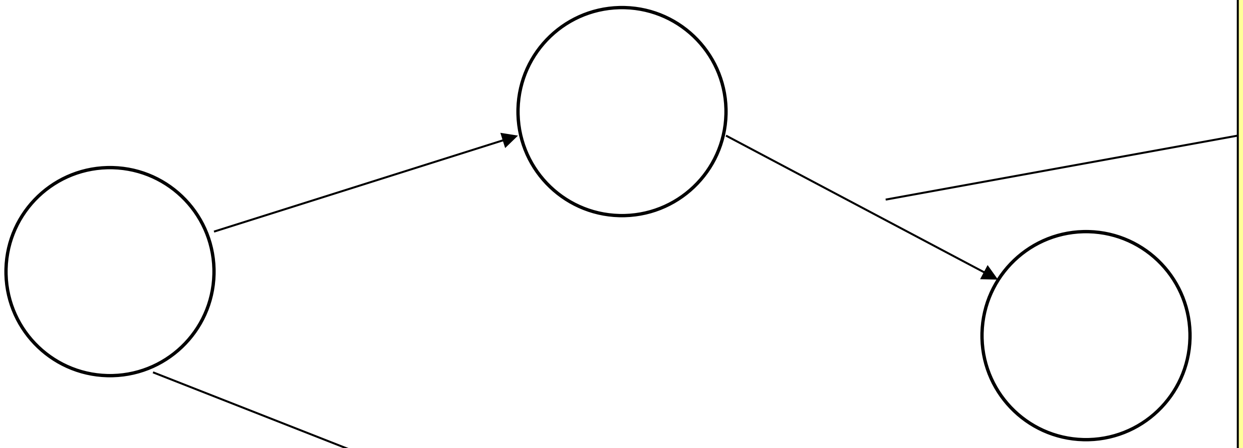
State Machine and Activity Diagram

State Diagram are closely related to:

- Finite State Automaton
- Petri Nets
- David Harel’s Statecharts

Activity diagrams can be seen a special types of State Diagram

Finite State Automata



Transitions

Describe how systems/algorithms/... change from state to state.

Examples.

- after(15sec) (Time based)
- on_red (Event Based)
- ...

States

Represent “conditions” in which a system/algorithm/... can be found.

Examples.

- “Ready”, “Busy”, ...

Initial States

Accepting States

Finite State Automata (ctd)

Application of FSA is pervasive in Computer Science

Examples:

- Lexical Checker
- Formal Verification
- ...

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State Machine Diagram

State Machine Diagram

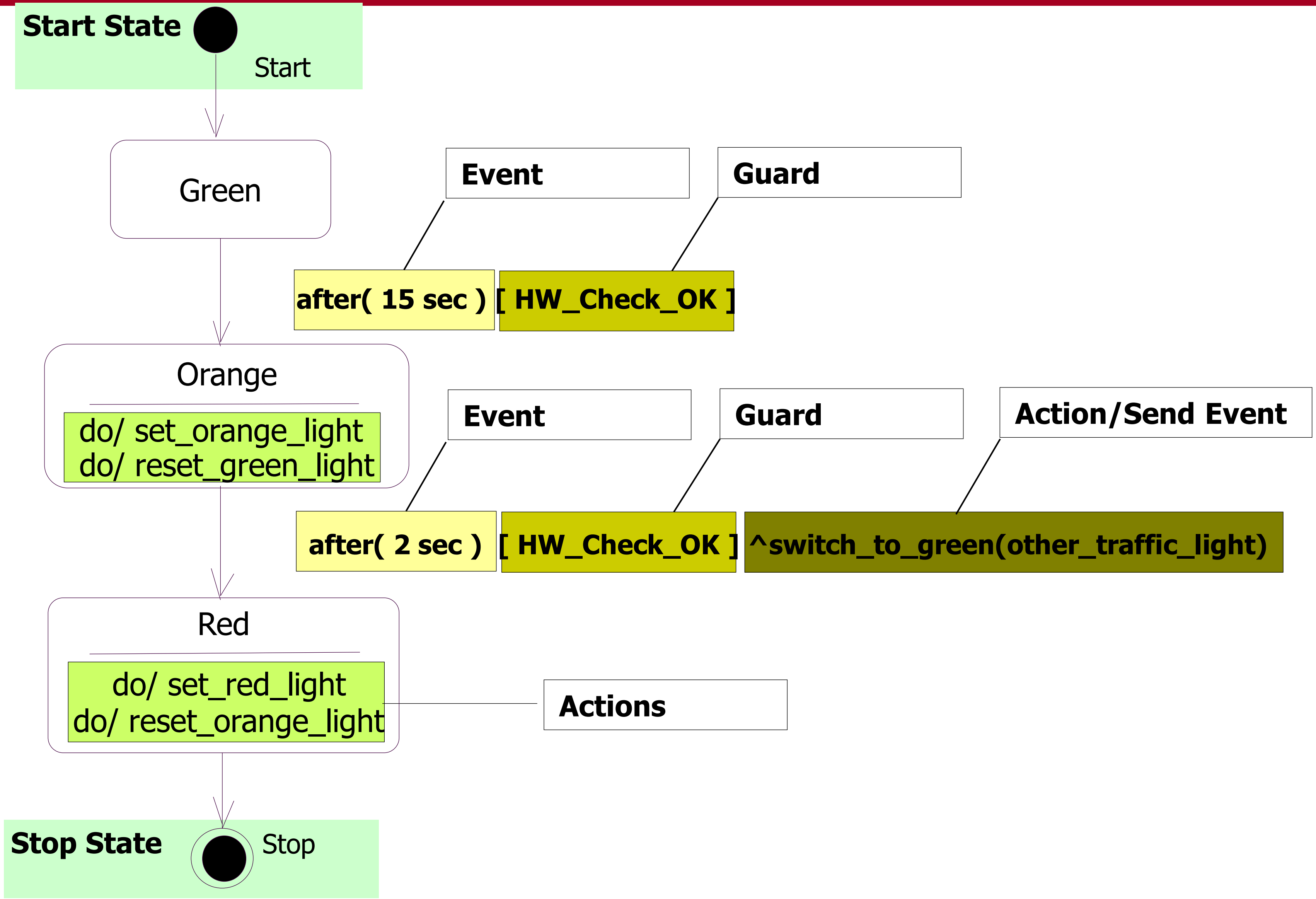
Definition:

A State Machine Diagram describes the sequences of states and actions through which an element (e.g. of the design) can proceed during its lifetime as a result to reacting to dicrete events.

Key Ingredients (… not surprisingly!):

- States (simple and composite)
- Transitions (event, guard, actions)

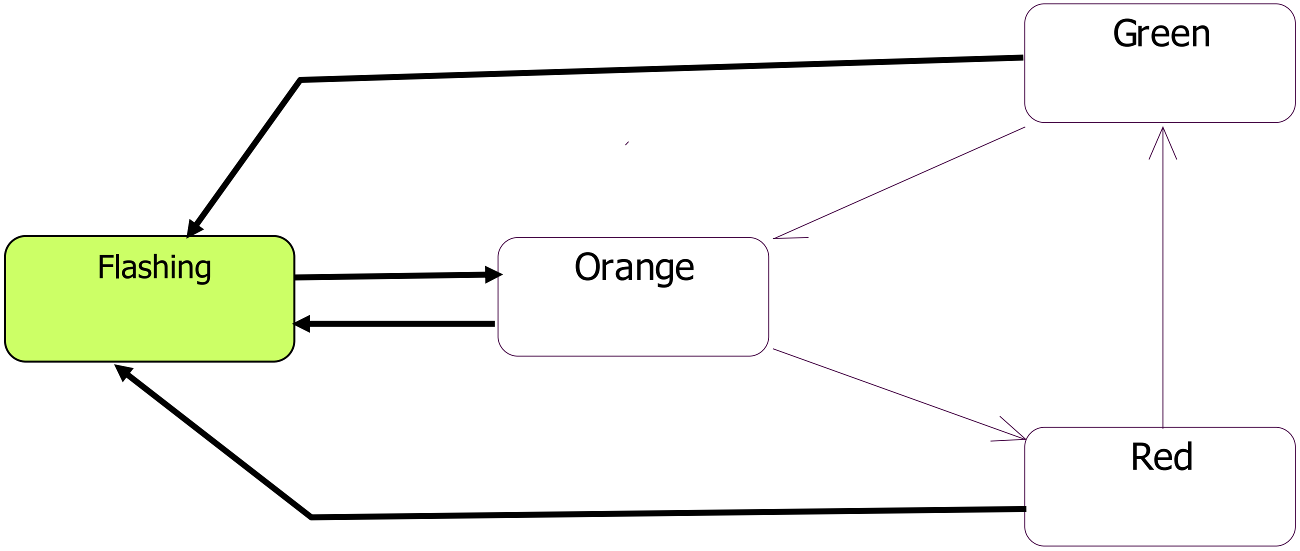
State Machine Diagram: Example



State diagram: Explanation

- Start State and Stop State: obvious
- Transition
  - **Event:** what may cause the transition
  - **Guard:** upon “event”, if true allows transition, if false prevents transition
  - **Action/Send Event:** if transition, then execute action/send event
- Actions within a state
  - **entry/** do action when entering the state
  - **do/** keep doing action while in state
  - **exit/** do action on leaving state

States: Hierarchical Decomposition



Issues:

- Cluttering of the diagram
- Structural information is lost

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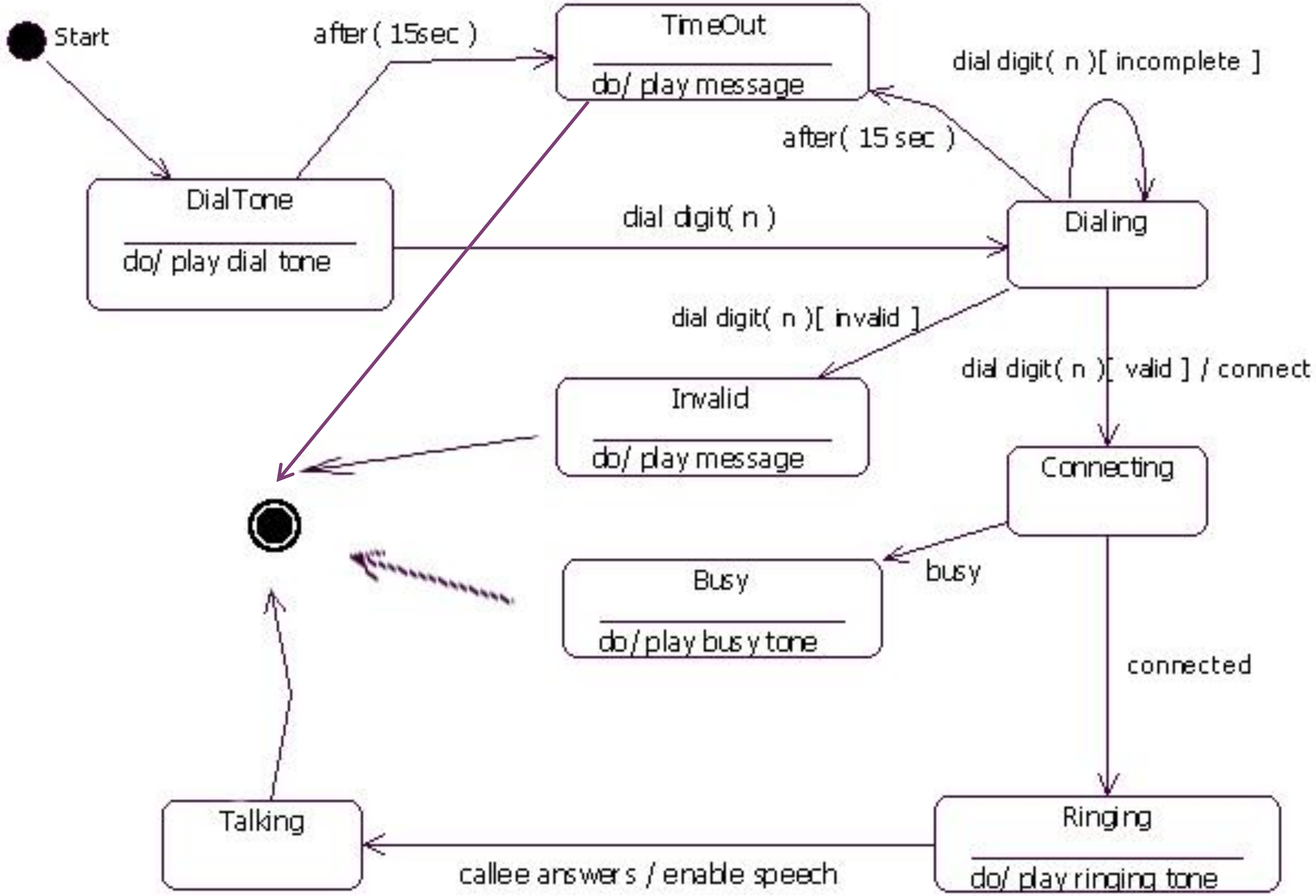
State Diagram: example

State Diagram: example

Phone Dialing

Specify, using statecharts, the process of placing a call with a telephone (e.g. when you lift the receiver, a dial tone is activated; then you can either …).

StateChart: example



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Activity Diagram

Activity Diagram

Definition

An activity diagram is a variation of a statechart in which the states represent the performance of actions and the transitions are triggered by the completion of the actions.

Key Ingredients

- Activities (States)
- Transitions (event, guard, actions)
- Merge/Fork/Join

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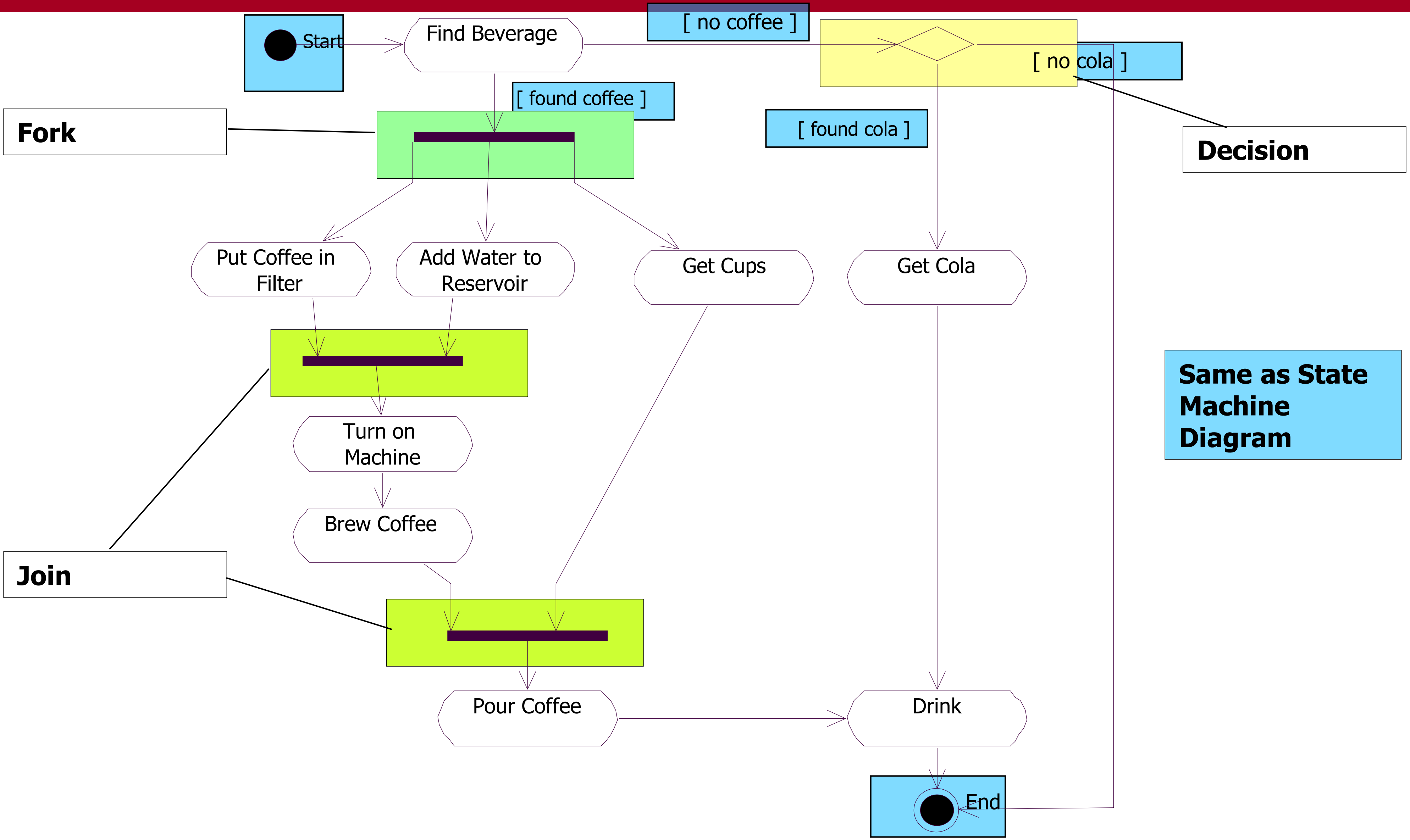
Activity Diagram: example

Activity Diagram: example



Same as State Machine Diagram

Activity Diagram: Explanation

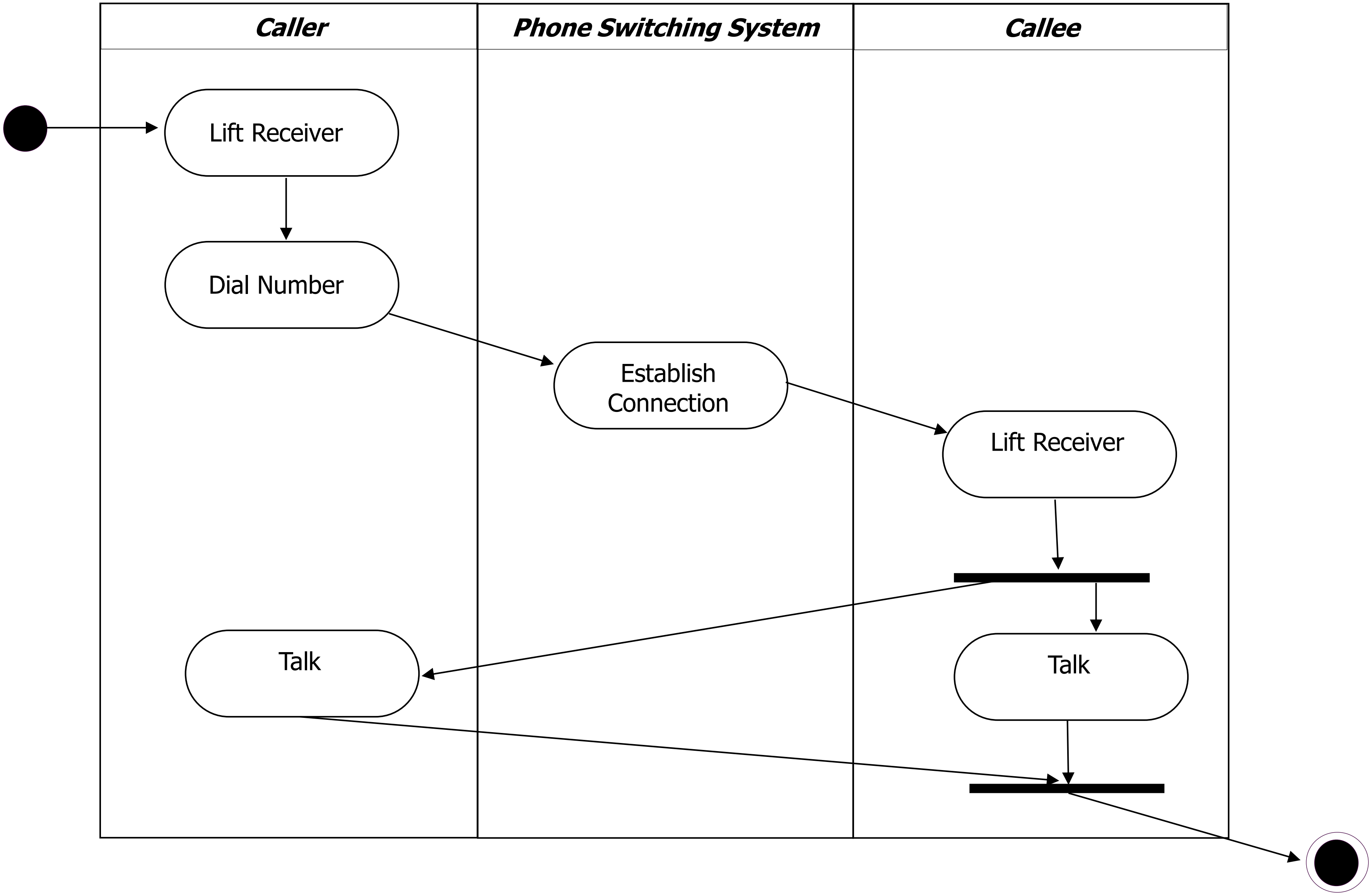
- Start/Stop/Activity/Guard: obvious
- Fork: allows for the parallel decomposition of activities.
- Join: synchronises parallel activities.
- Decision: conditional behavior.

Swimlanes

Sometime it is useful to highlight responsibilities in activity diagrams

Activities diagrams allow to do that with “swimlanes”

Swimlanes: Example



Sequence Diagrams vs Activity Diag.

- Sequence Diagram: description of **the whole system**

- Activity Diagram: description of **a part of the system** (usually an Use Case)

State and Activity Diagrams

Use them when really necessary!!!

(e.g. complex interactions, (in)formal verification,
business process definition and enhancement,
…)