Introduction to SysML

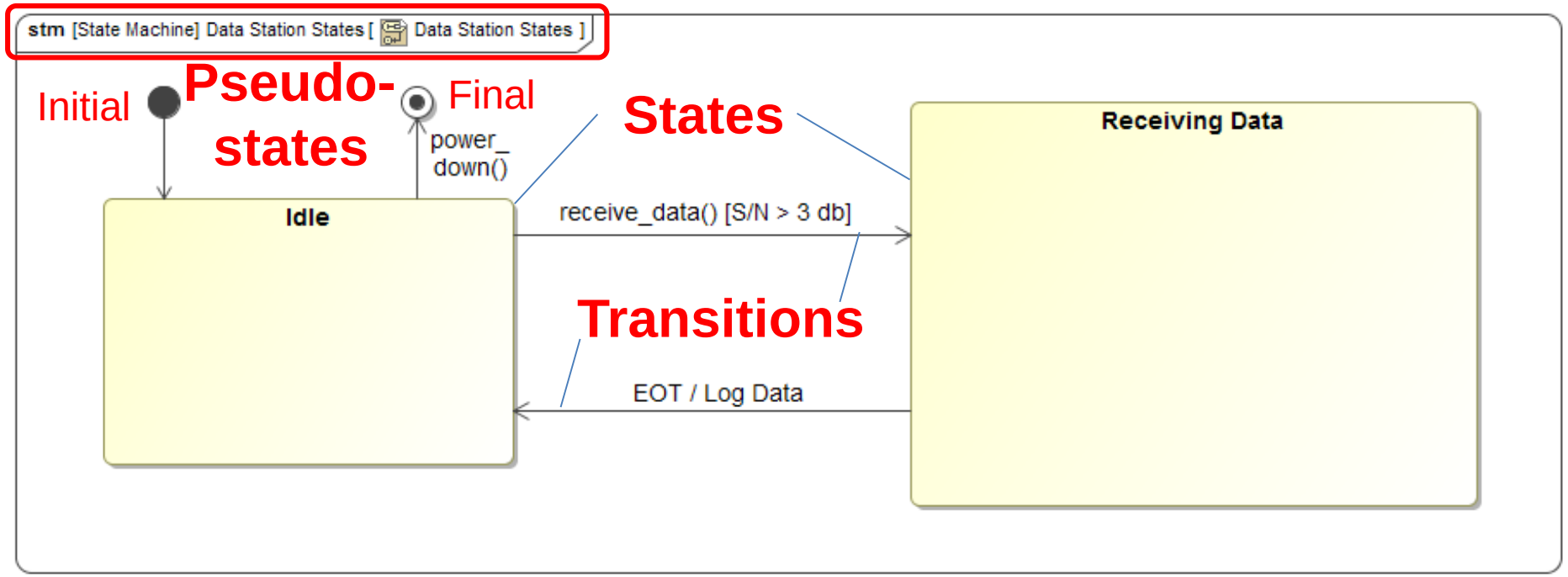
Part 8.0: State Machine and Sequence Diagrams

With tutorial exercises using Magicdraw

State Machines

- State Machine is a kind of Behavior
- State Machine Diagram is a view of a State Machine
- A State is a collection of Behaviors that the system exhibits at some stage of its lifecycle or under certain conditions
- States are mutually exclusive within a State Machine
- A State Machine can be in one and only one state at a time
- A Transition is an allowable path from one State to another
- State Machines are often the top-level Classifier Behaviors of Blocks
- State Machines are a compact way to describe systems with distinct operating modes and subject to many internal and external factors

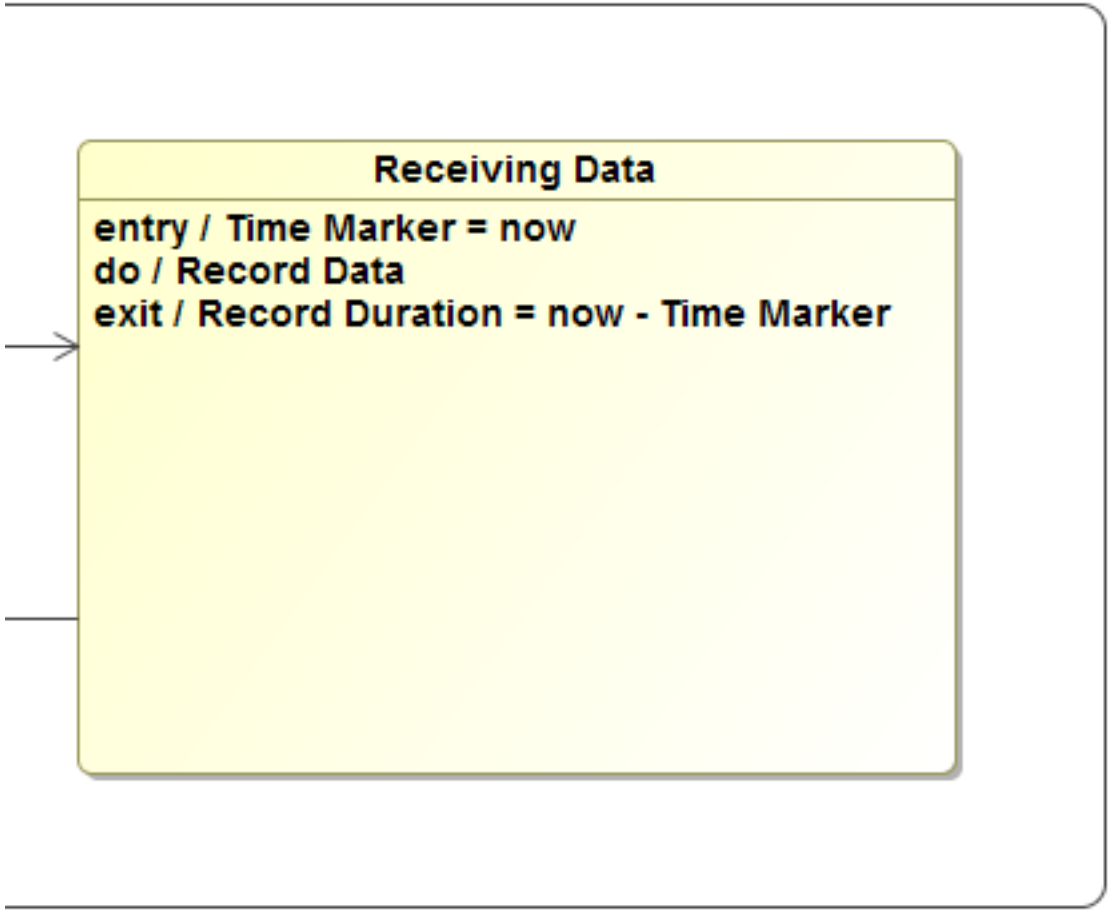
State Machines



- Initial Pseudostate identifies first state after state machine becomes active.
- Final State identifies state system must be in to terminate the state machine.
- If no Final State symbol, state machine may terminate from any state.

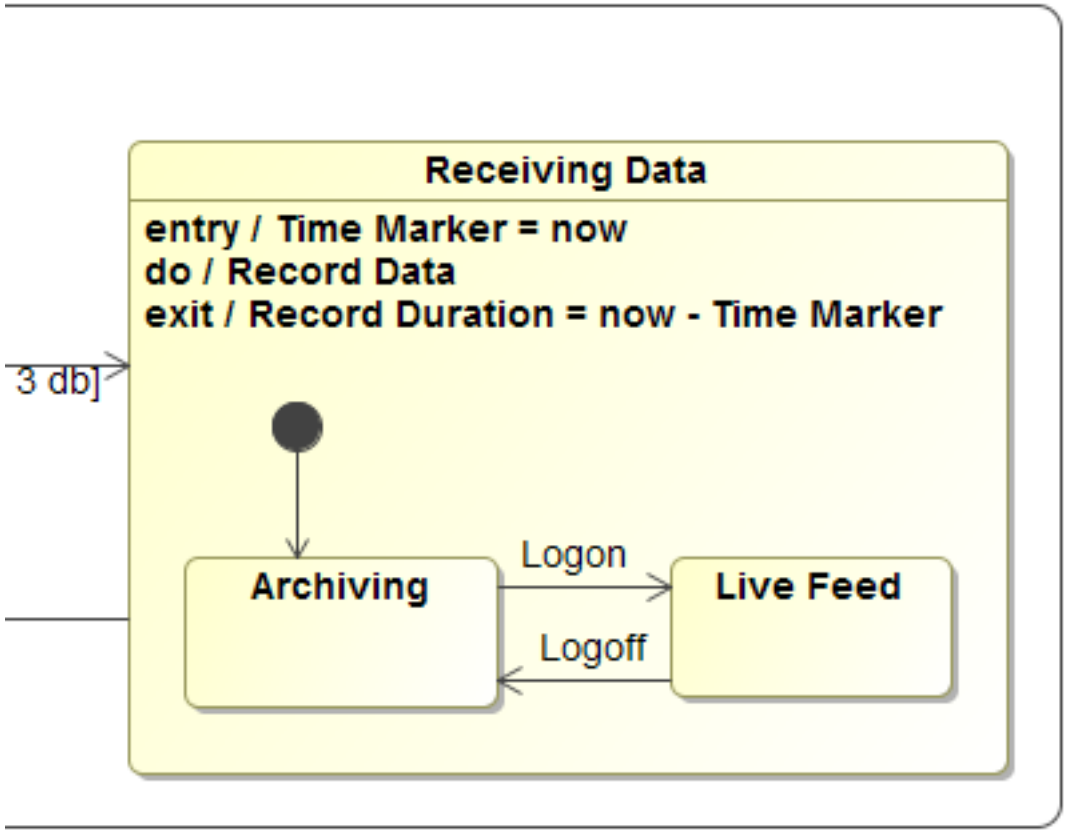
States

- A State is a collection of Behaviors.
- The text inside a State lists them
  - Entry – behaviors carried out as soon as the state is entered
  - Do – behaviors carried out while the system is in that state (or until natural completion)
  - Exit – behaviors carried out just before the system transitions out of a state



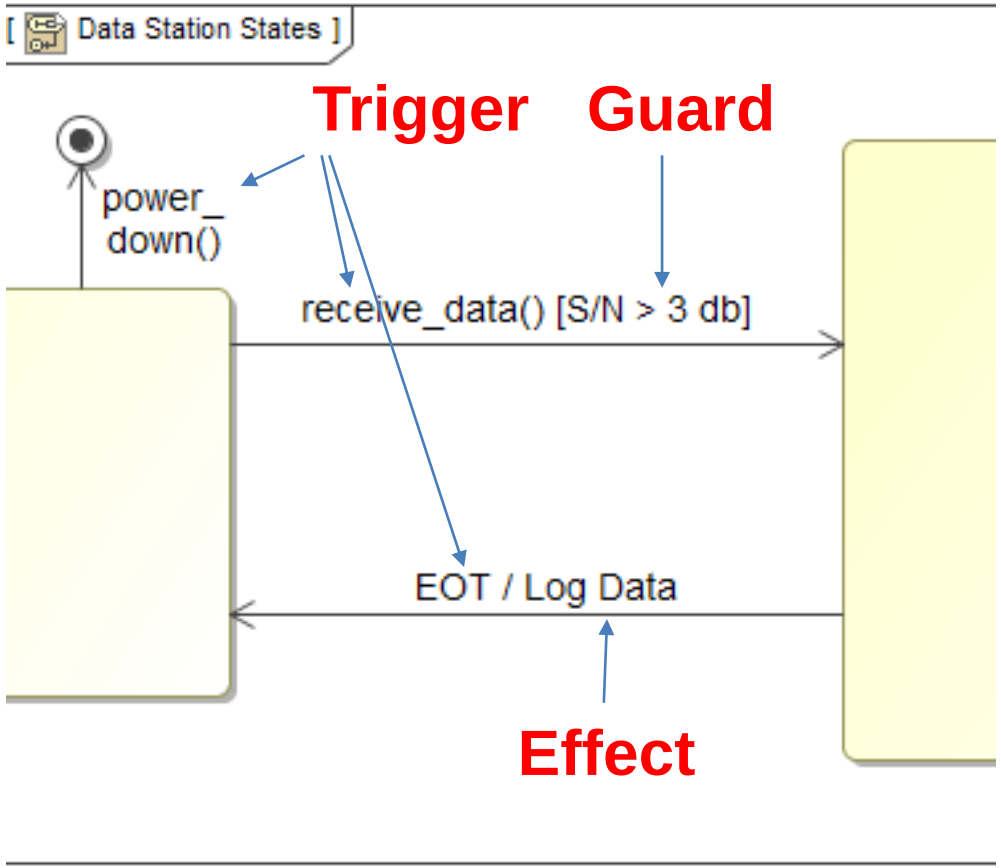
States

- States can contain State Machines as do behaviors.
- Such a State is called a Composite State.
- A Composite State can contain more than one State Machine.
- These parallel State Machines are called Concurrent Behaviors.
- SysML uses an organizing element called a Region to separate States in different State Machines.

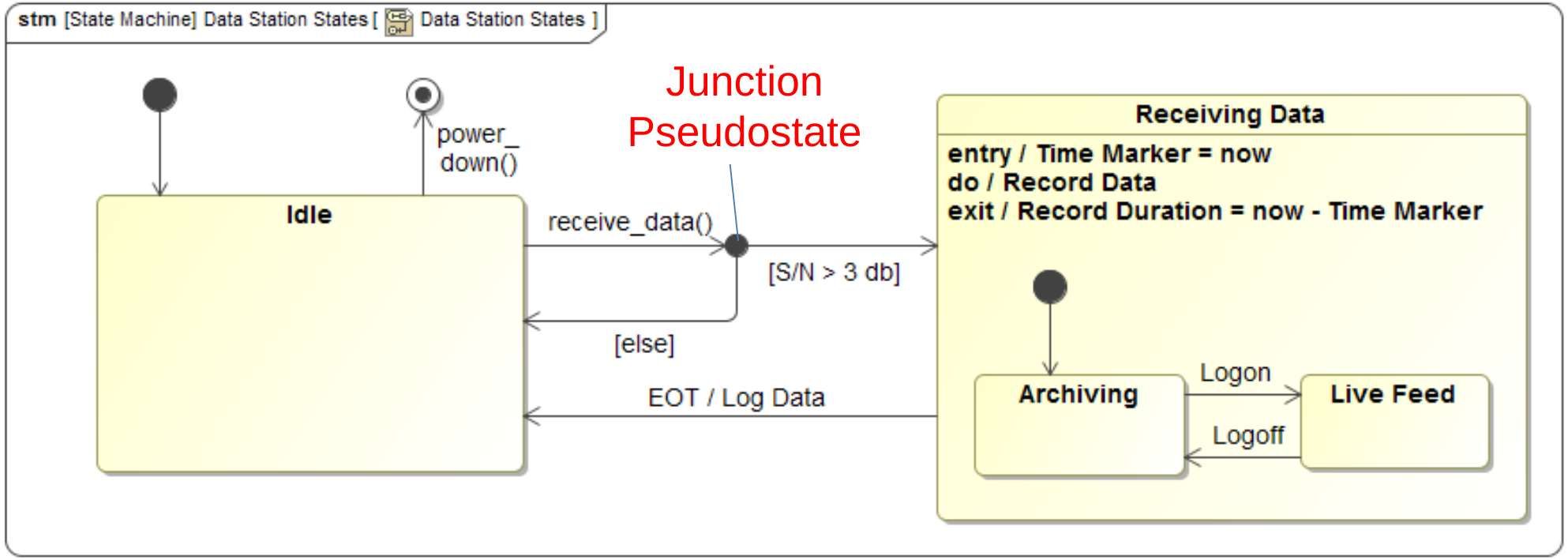


Transitions

- **Triggers [Guard] / Effect**
- A Trigger is an Event that causes a transition to occur
- These may be Call, Signal, Time, Change or Completion events
- Every Transition must have at least one Trigger, though it may not be shown
- A Guard is a condition that must be true for a Transition to occur
- An Effect is a Behavior that occurs during the Transition.

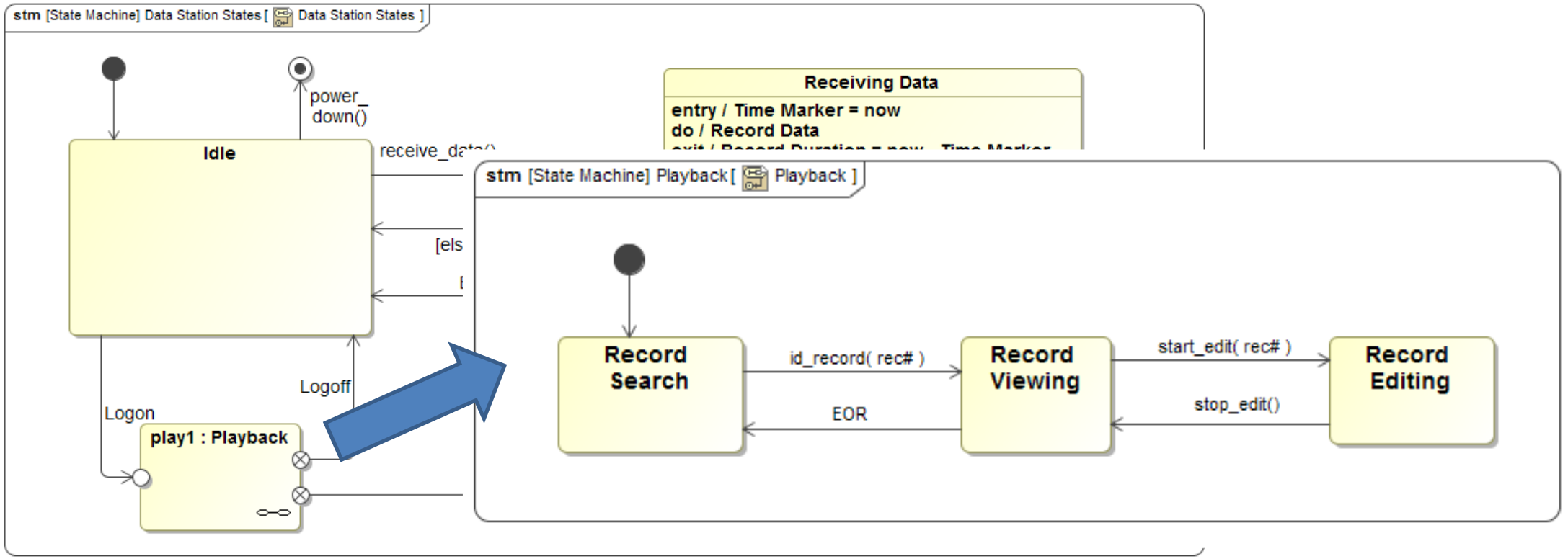


Transitions



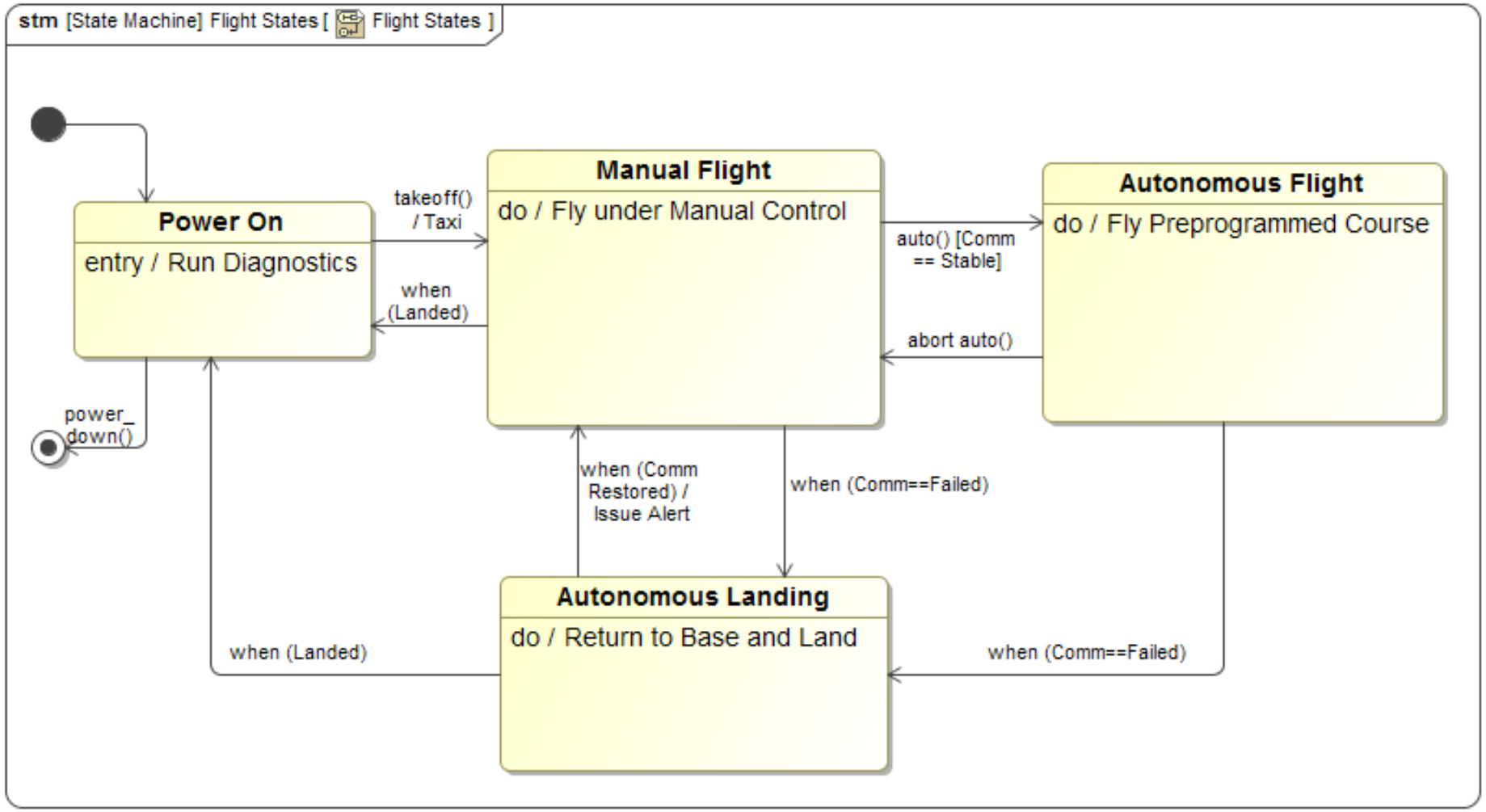
- A Junction Pseudostate allows a Transition to branch, controlled by Guard conditions.

Submachine State

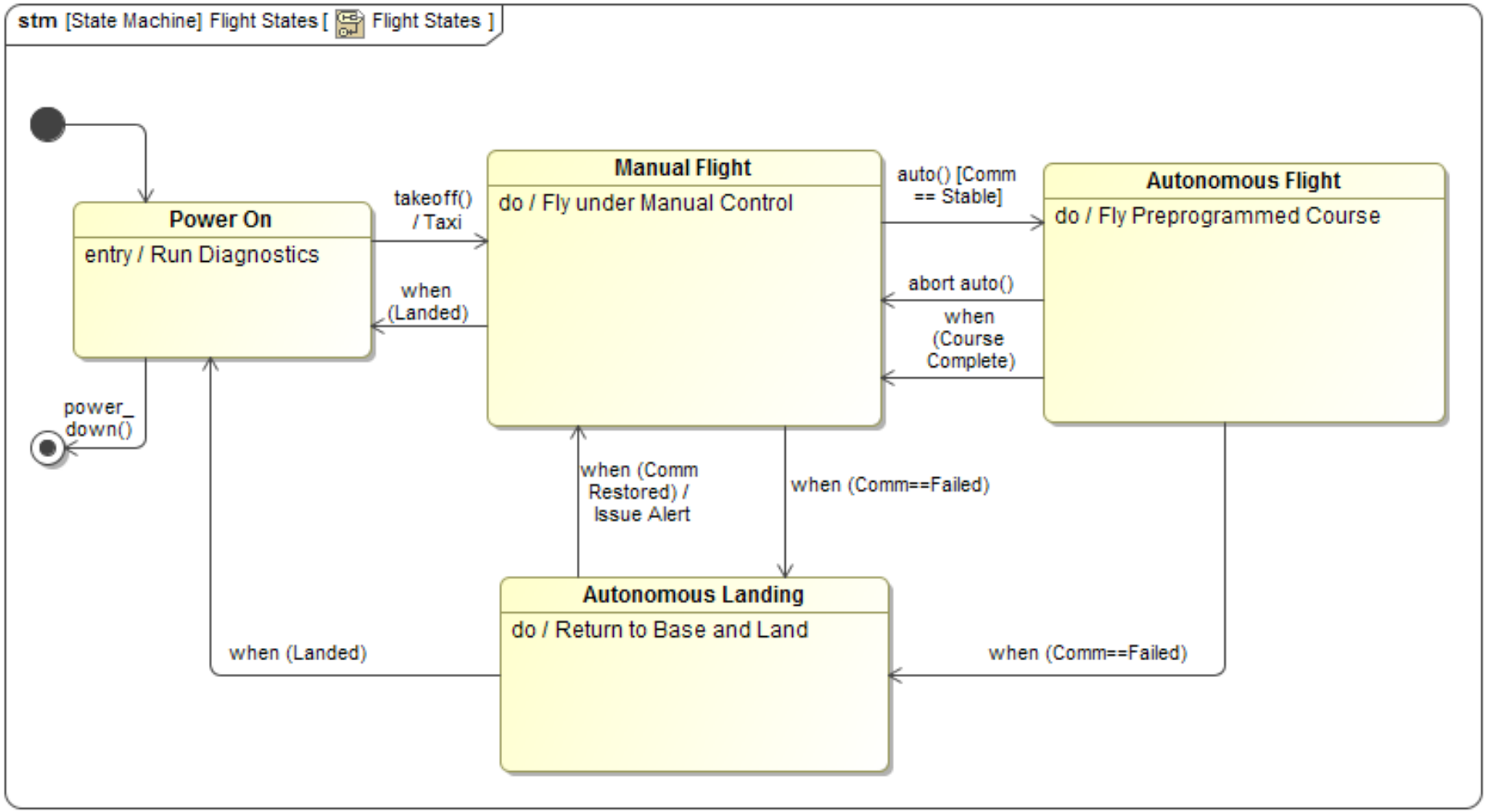


- A Submachine State is a usage of a State Machine in a higher-level State Machine Diagram. The small state machine icon in the lower right corner and the entry and exit points identify it.

UAV Flight State Machine

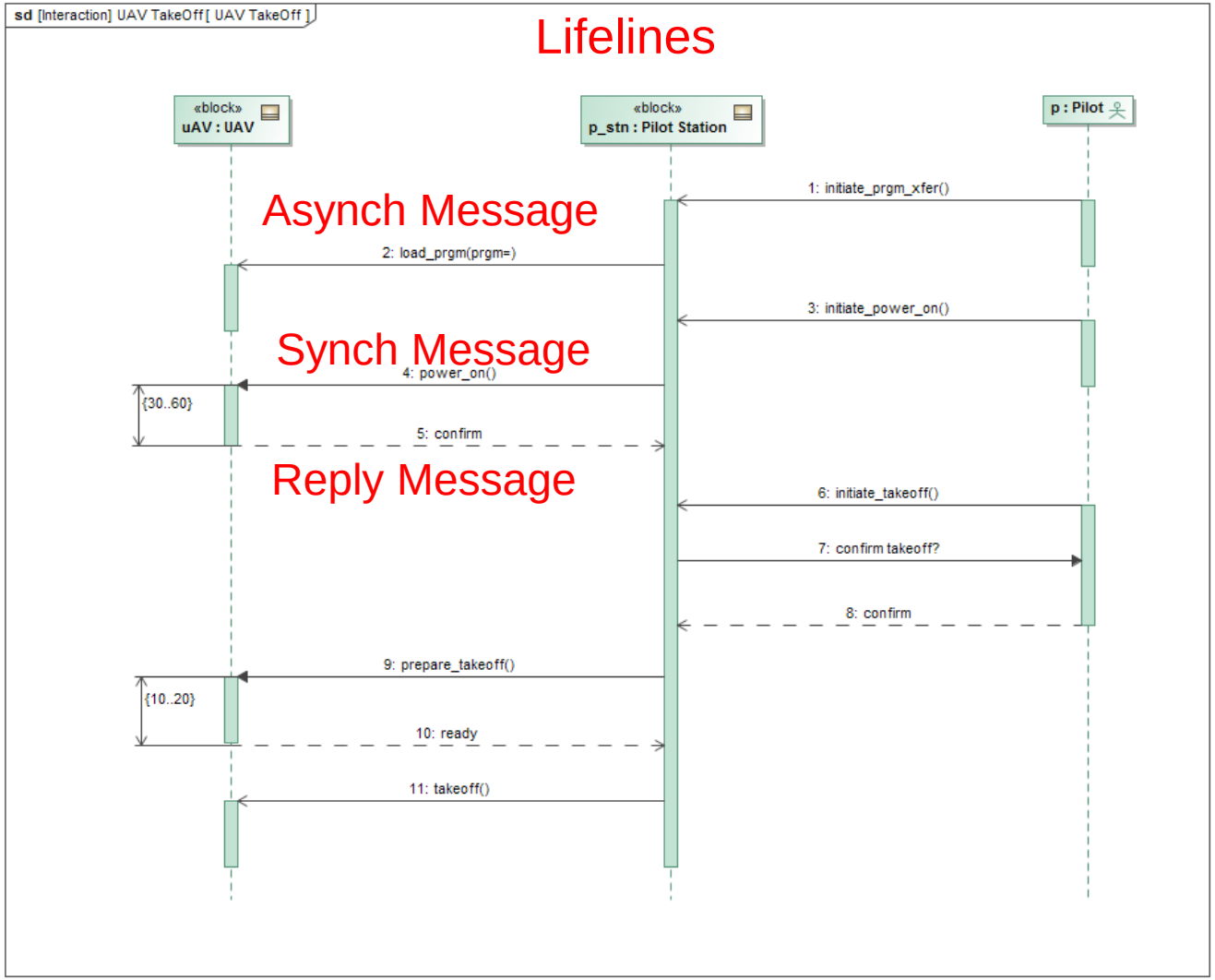


First Exercise



Review - Interactions and Sequence Diagr

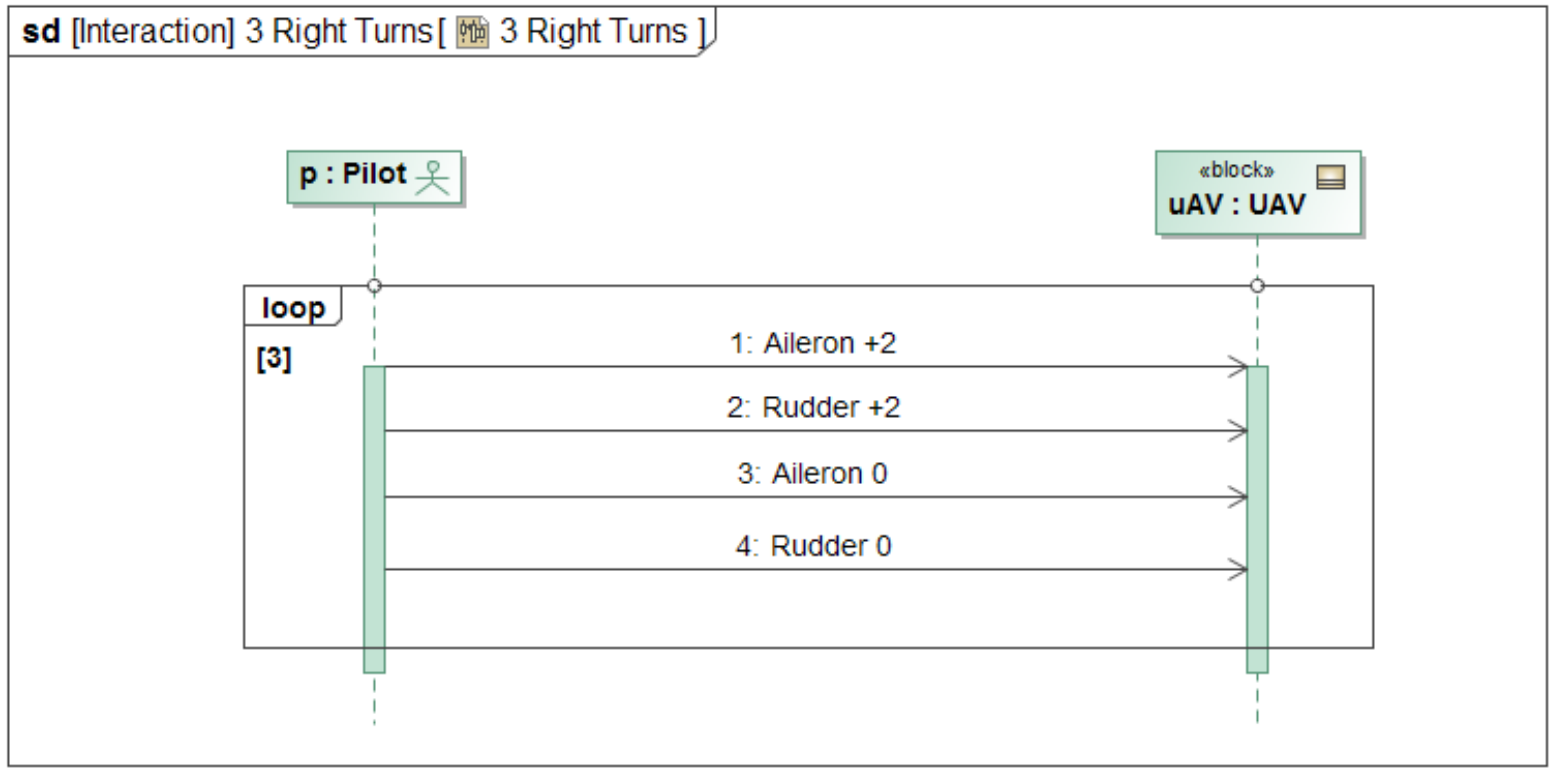
- Interactions model message-based behaviors
- A Sequence Diagram shows the internal elements of an Interaction
- Lifelines represent part properties, parts of the system or domain
- Messages can be synchronous, asynchronous or reply, and are read from the top down.



Combined Fragments

- A Combined Fragment consists of an interaction operator and a frame containing one or more messages
- Four important ones are Loop, Opt, Alt, and Par
- Using a combination of fragments, including nesting, very complex multibranch scenarios can be modeled

Combined Fragments



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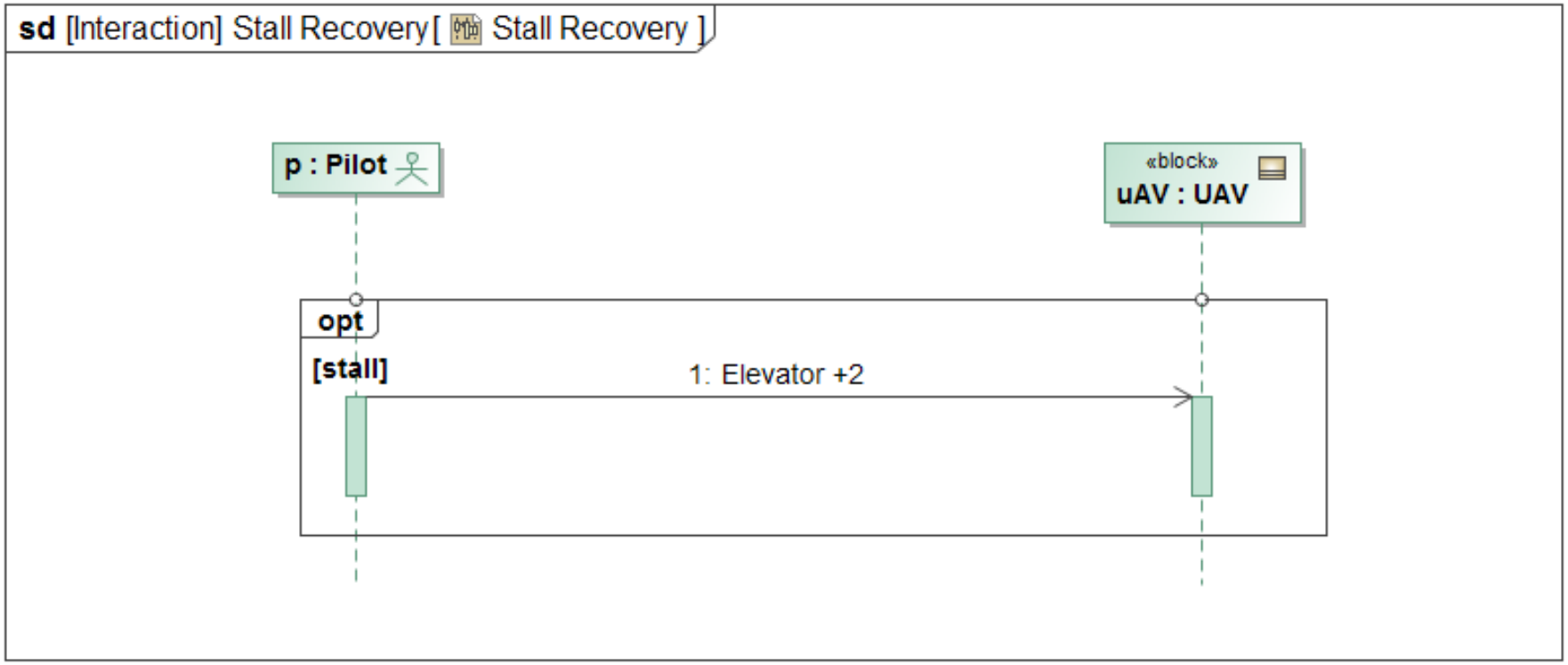
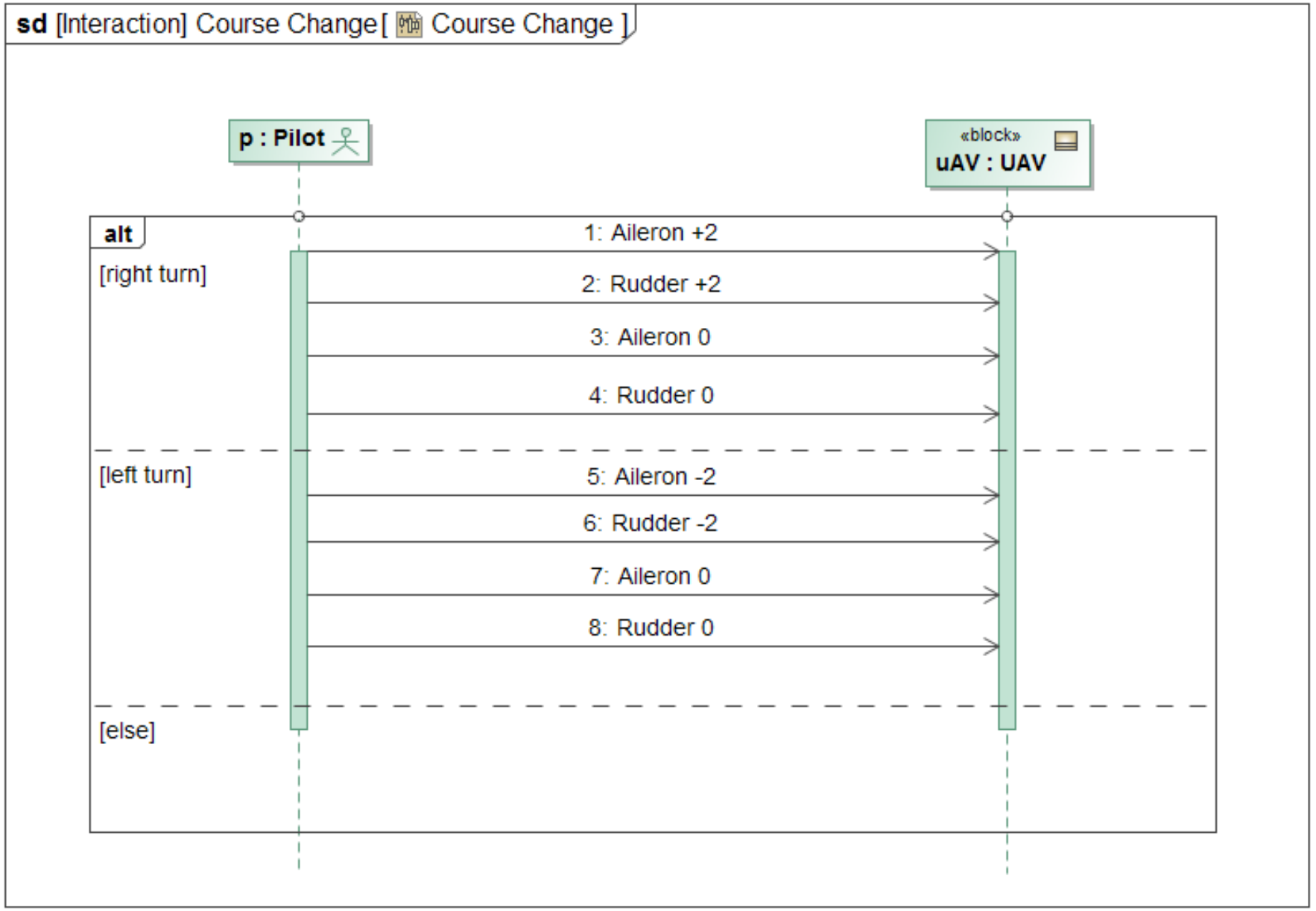
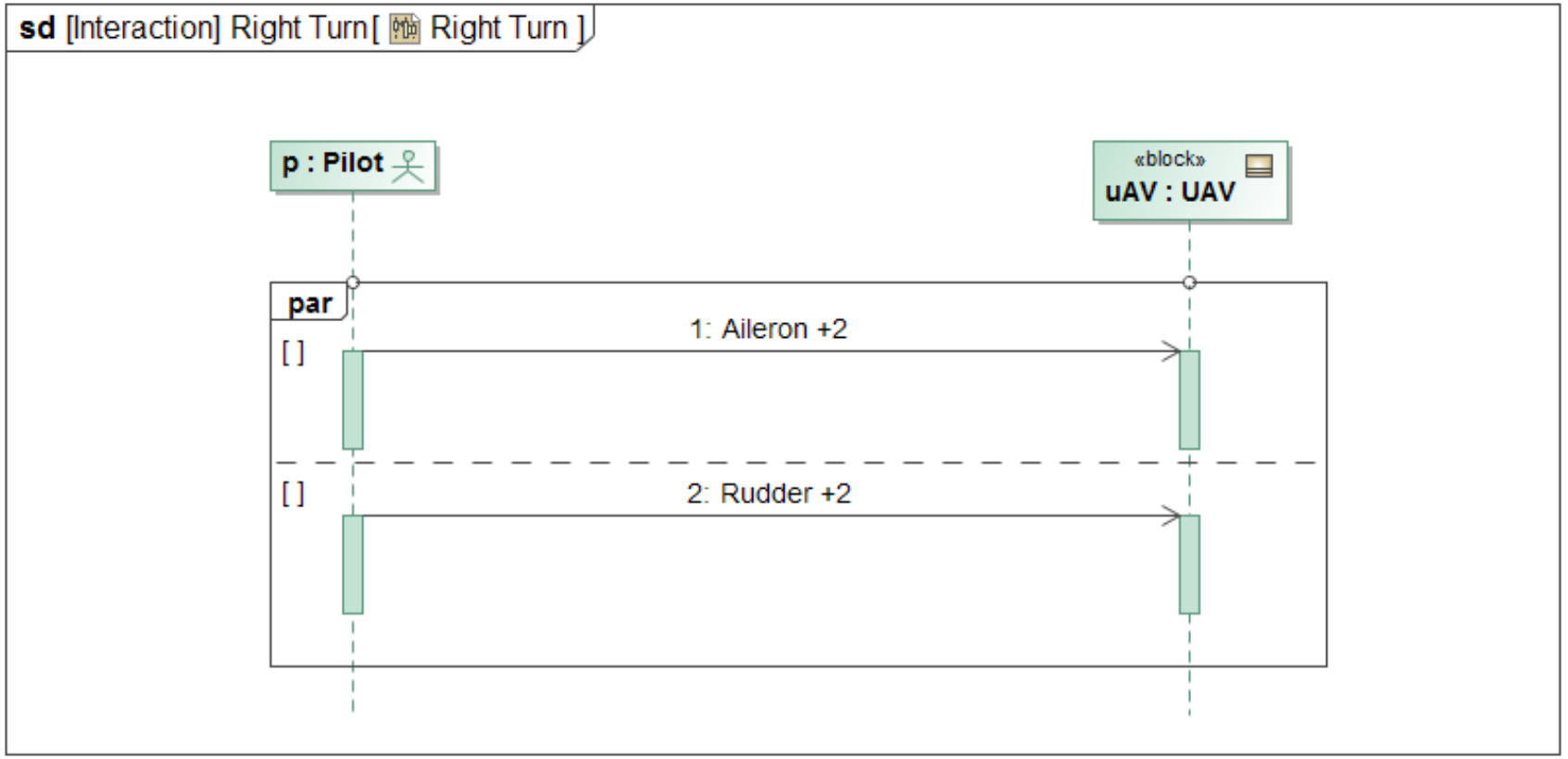


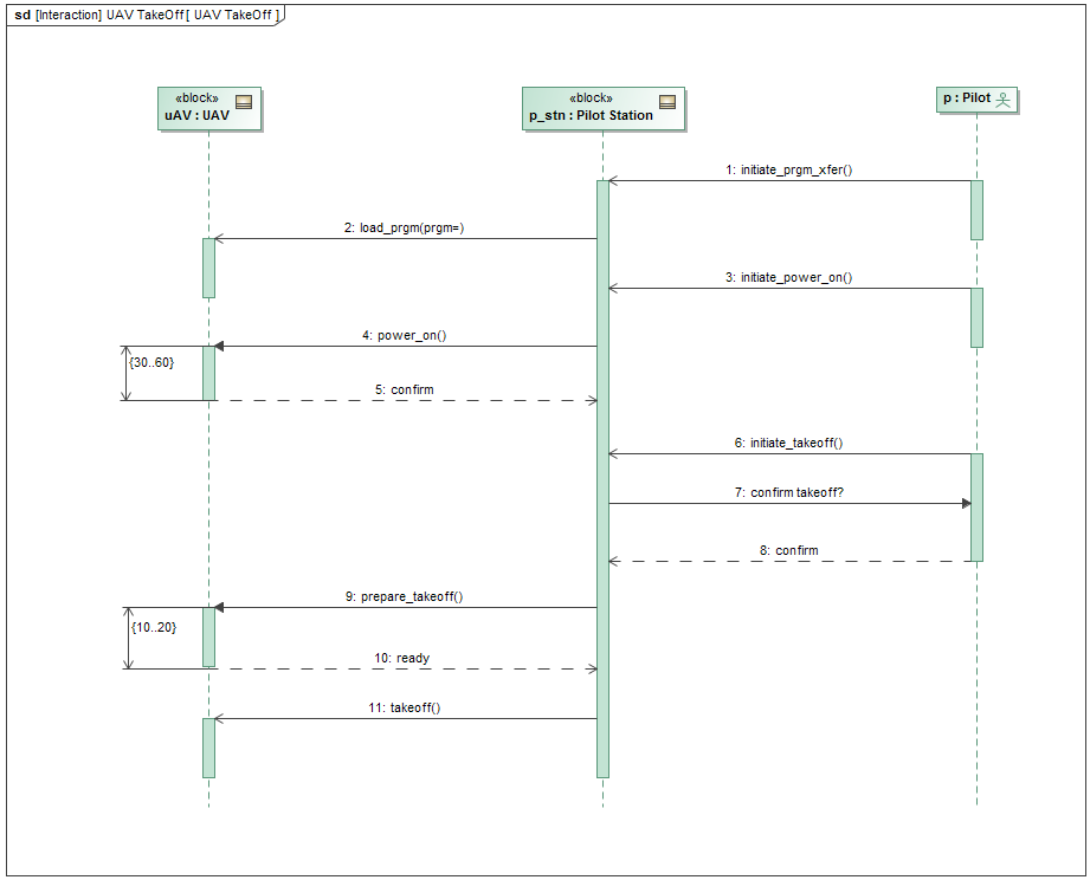


Combined Fragments



Interaction Uses

- Interaction Uses reference a lower-level interaction in a higher-level sequence diagram



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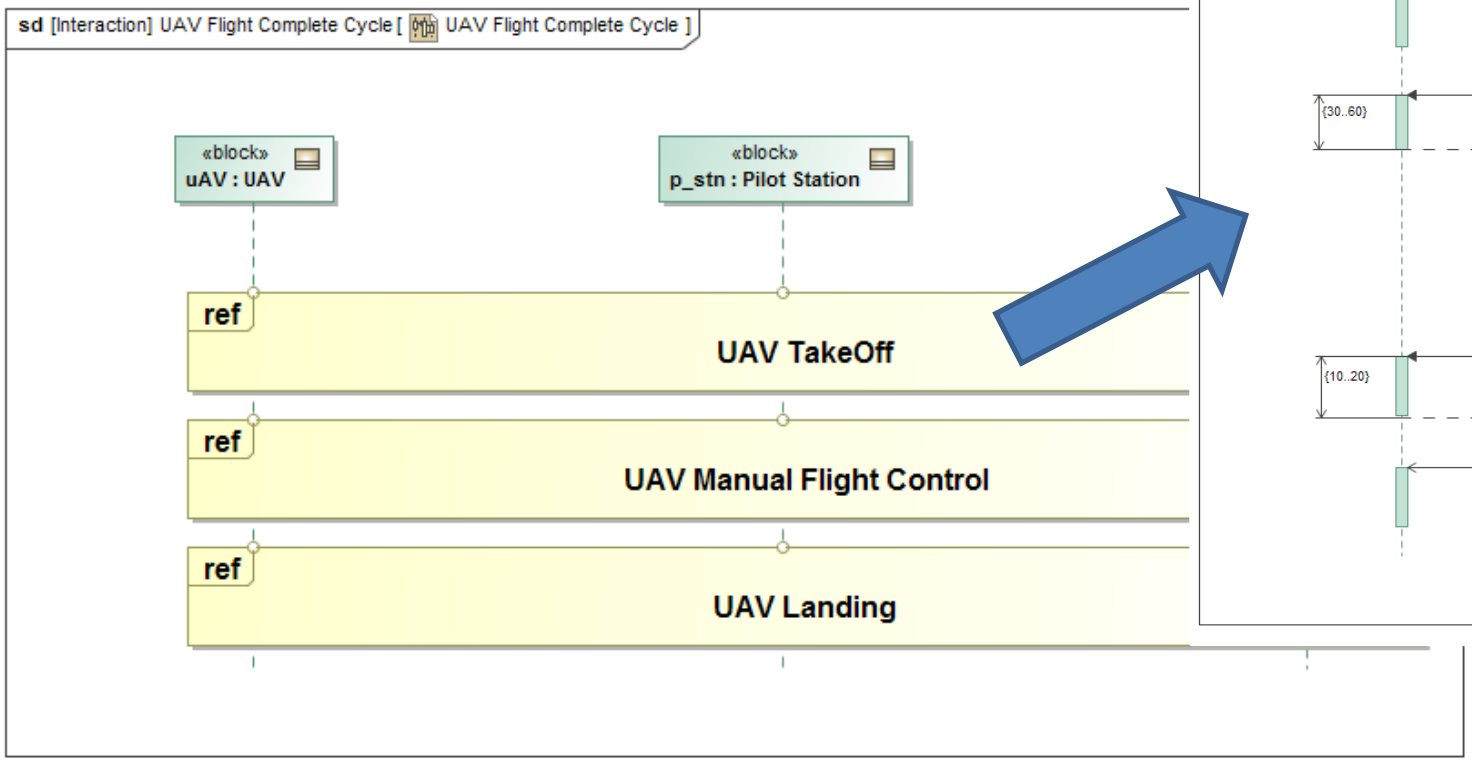
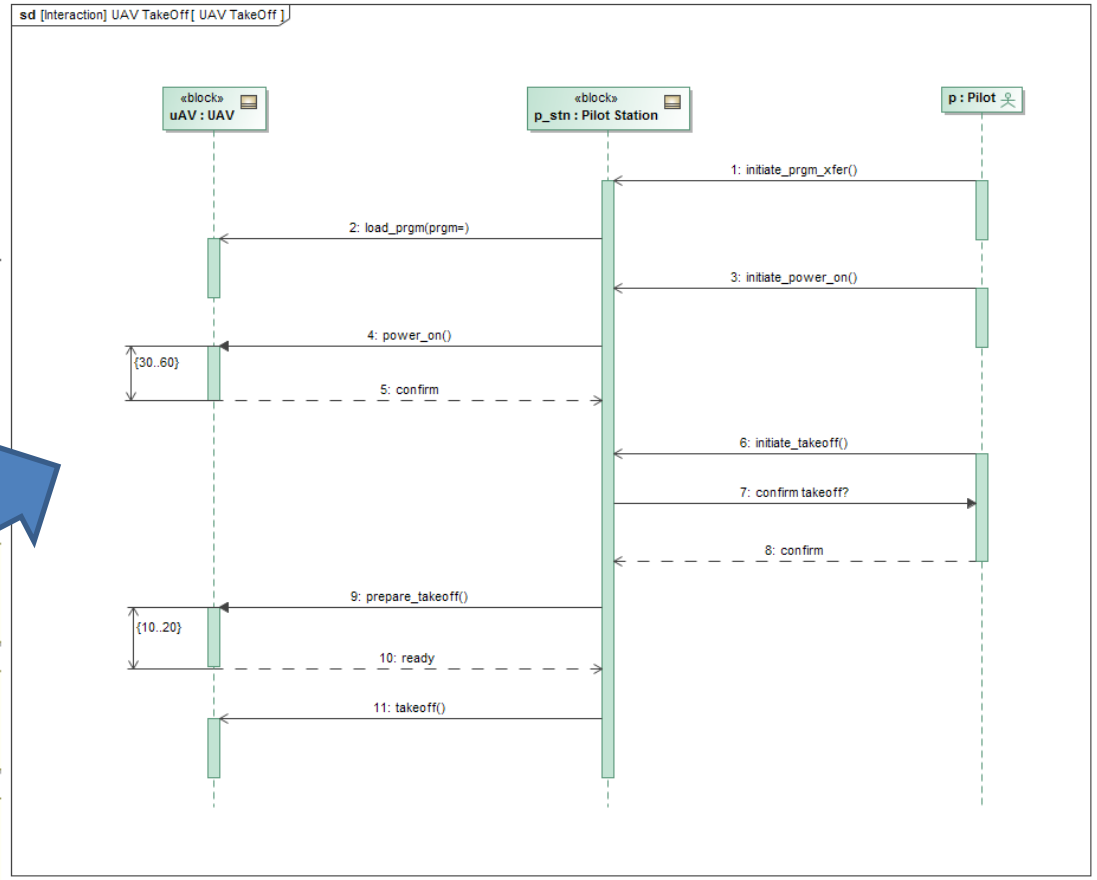
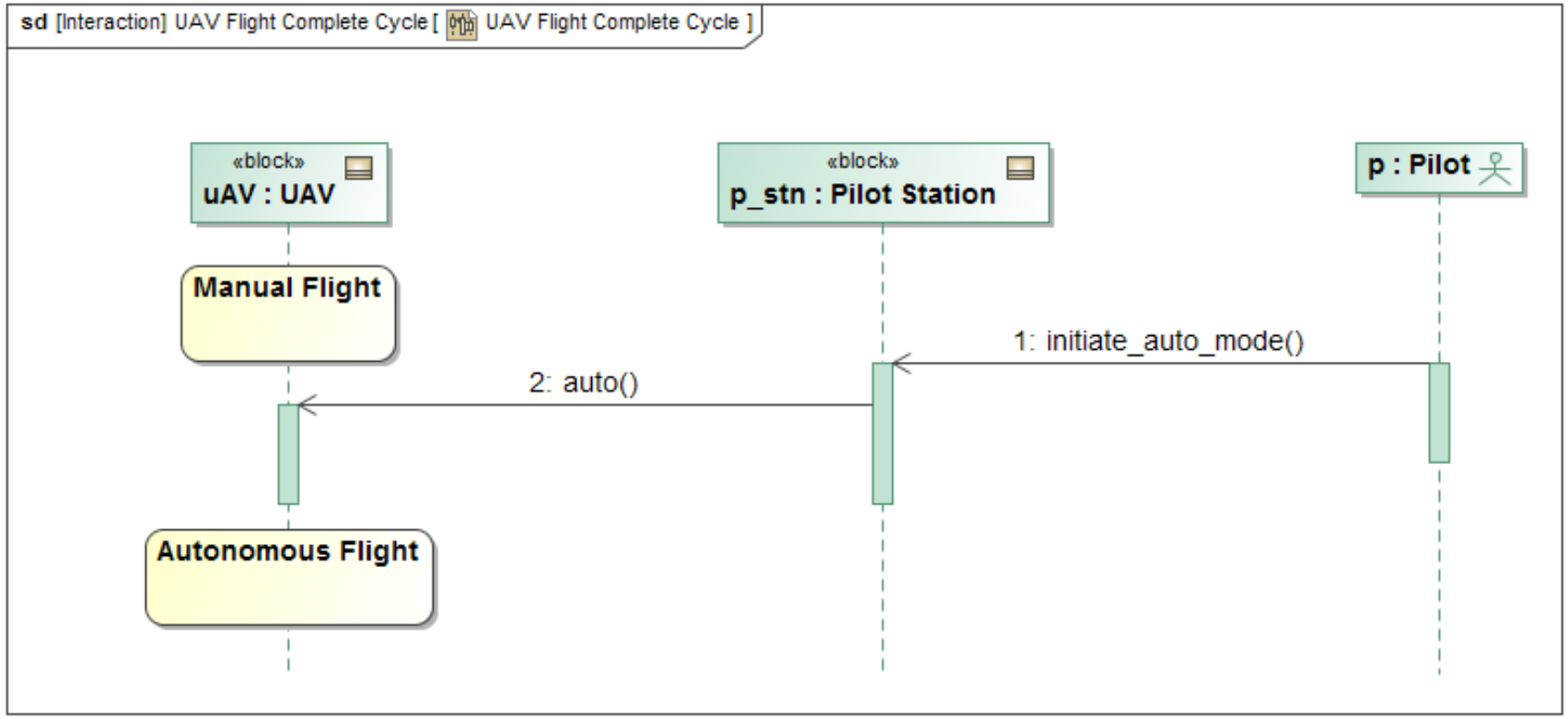




State Invariants

- State Invariants show the State that must be active for the following messages to be valid



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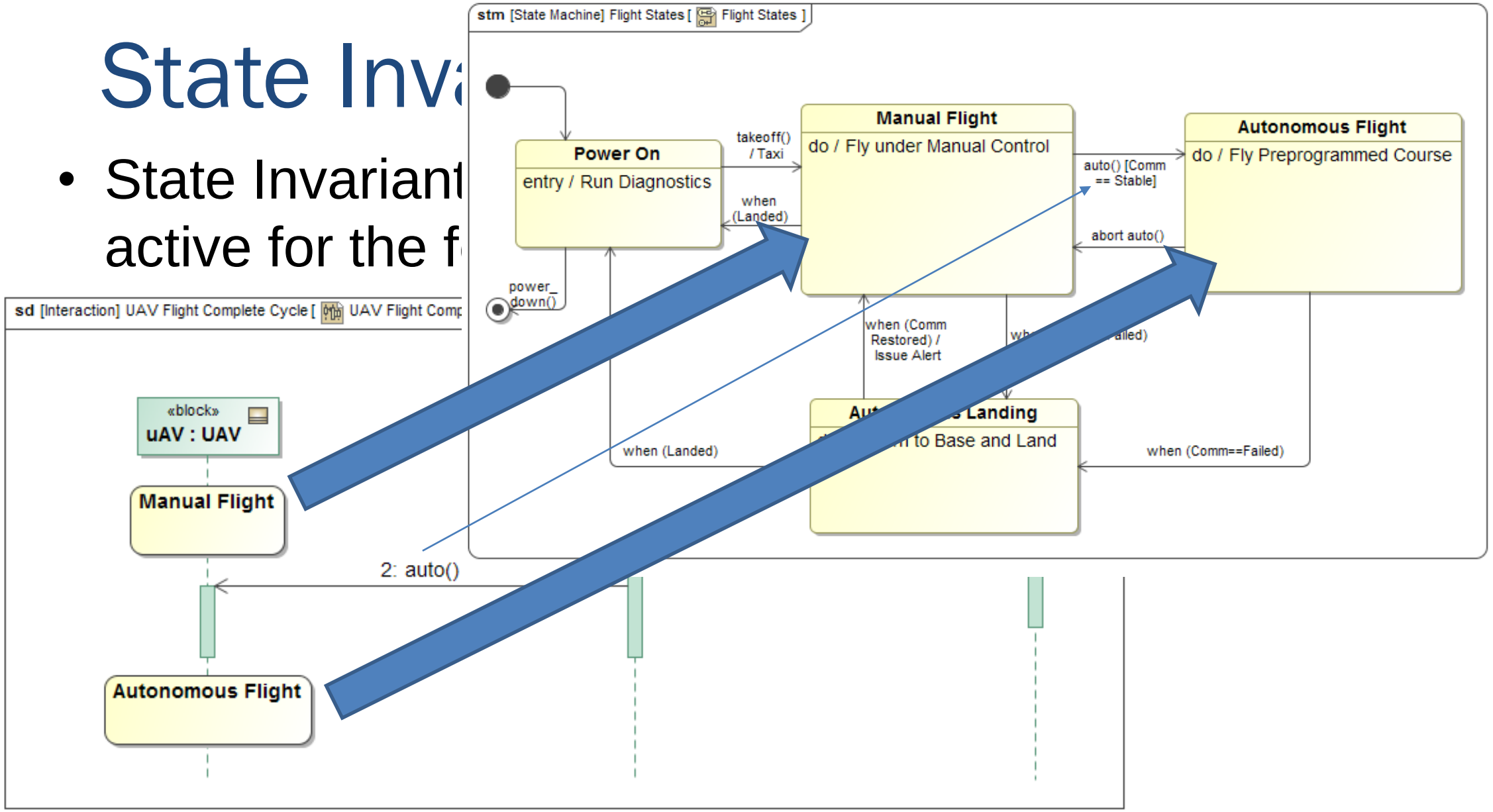

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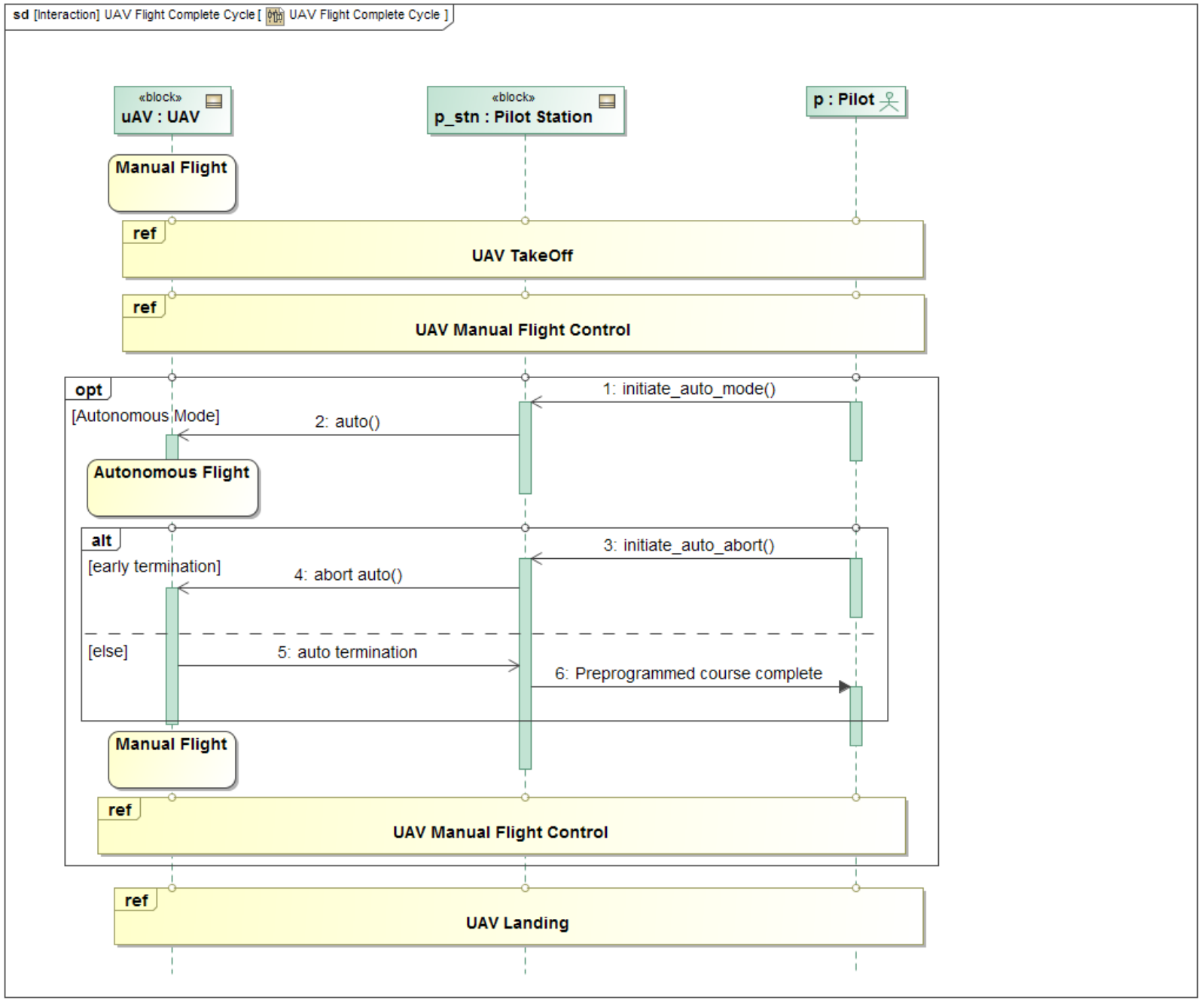

Recap

- At the end of the hands-on exercises, you should be able to
  - Explain the following terms: state, transition, pseudostate, combined fragment, interaction use, submachine state, trigger, guard, effect
  - Create a state machine diagram
  - Create combined fragments and interaction uses in a sequence diagram
  - Identify the principle purpose(s) of state machine diagrams

Questions?

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