Introduction to SysML

Part 4.0: Requirements and Interactions for Scenarios

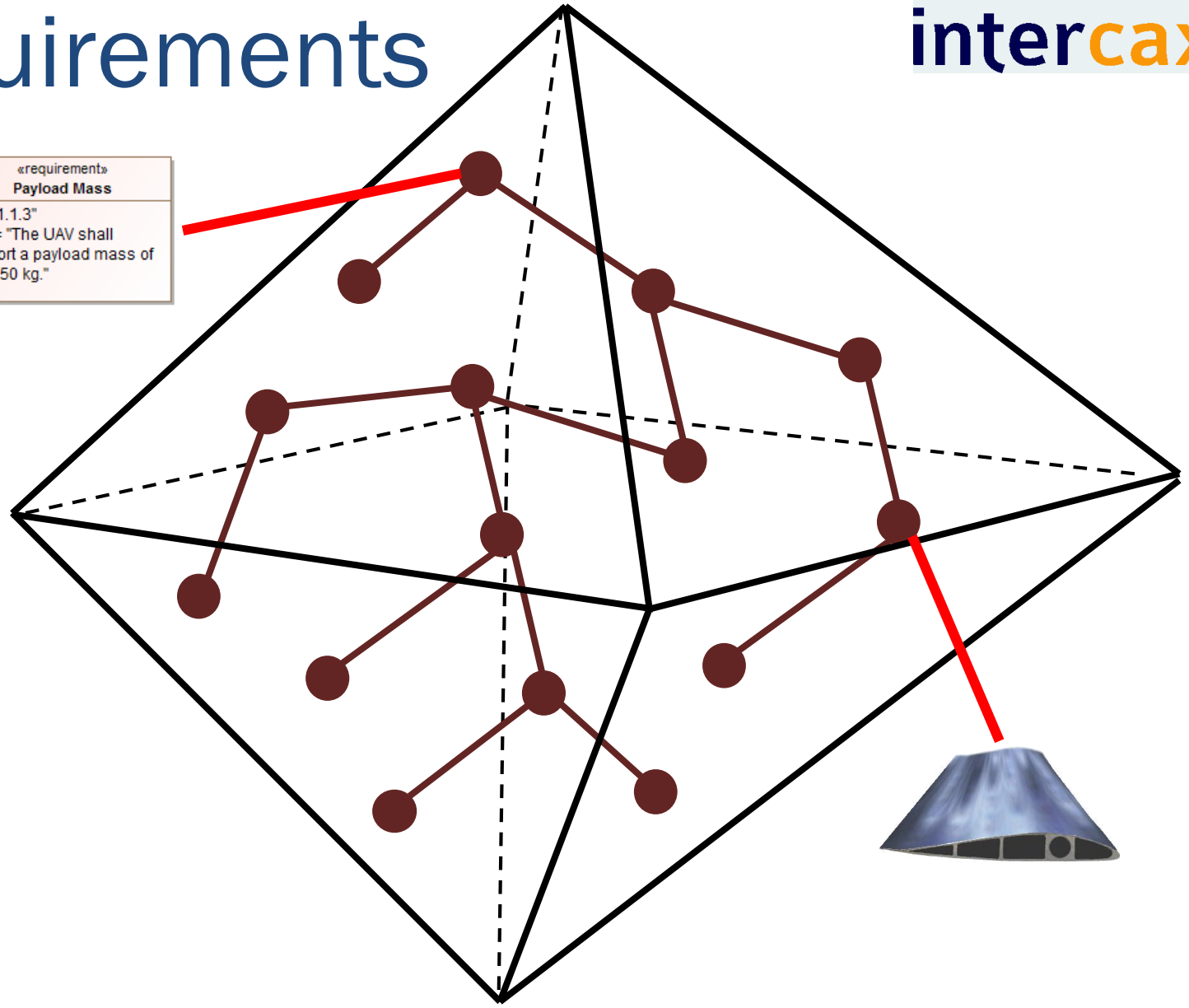
With tutorial exercises using MagicDraw

Learning Objectives

- Requirements Diagrams, Tables and Matrices
- Dependencies in Requirements Models: Satisfy, Verify and others
- First exercise, building requirements diagrams and table
- Interactions and Sequence diagrams
- Second exercise, creating a concept-of-operations scenario

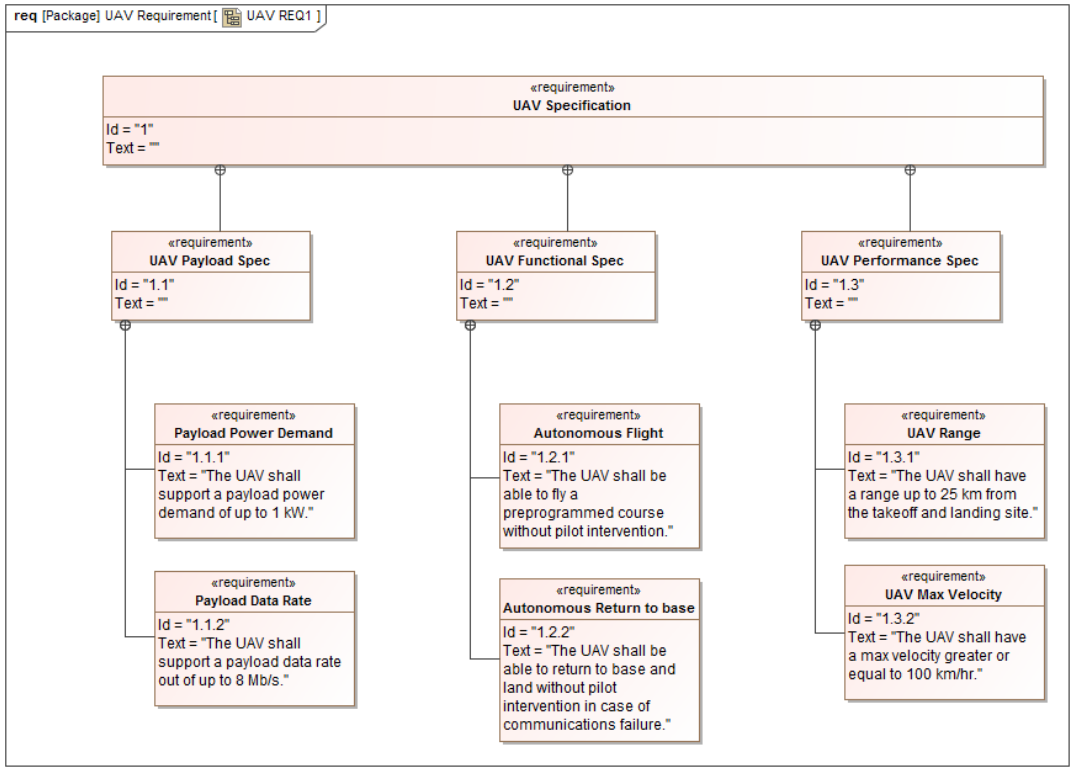
Why Handle Requirements in SysML?

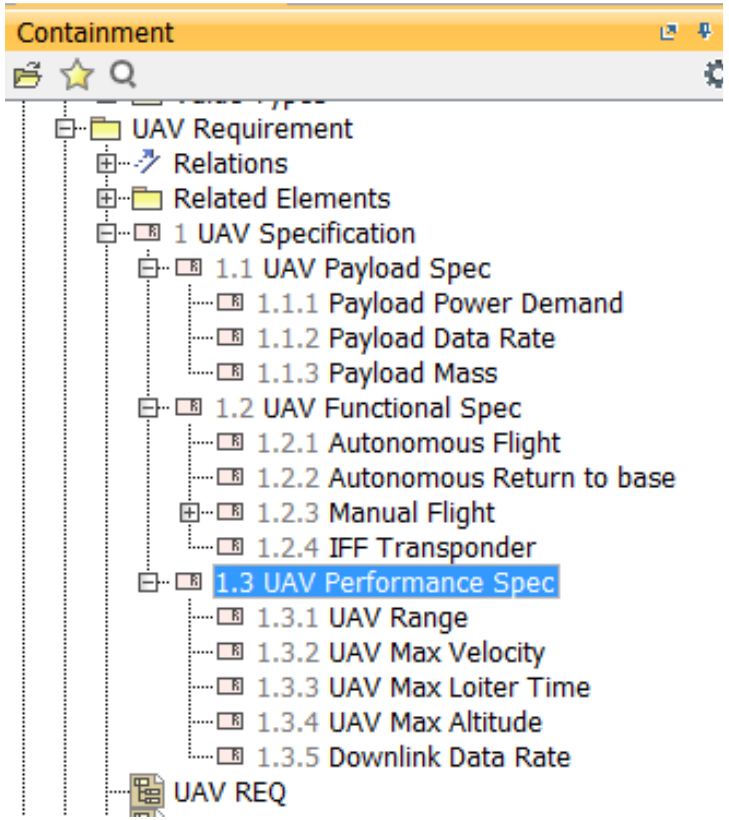
- The goal of MBSE is a single unified model.
- SysML provides a common ground where requirements are fully integrated, relationships are precisely defined, and traceability is maintained.



Requirement Diagrams

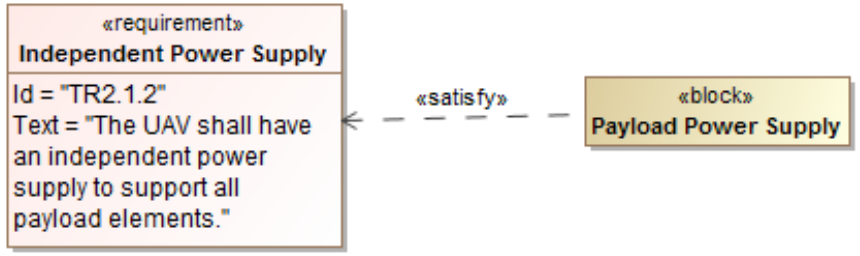
- First application – displaying requirement hierarchy
- Second application – creating and displaying dependencies linking requirements to other elements



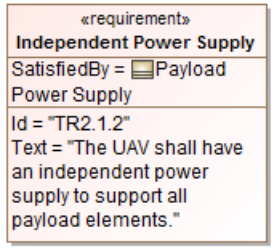


Dependencies

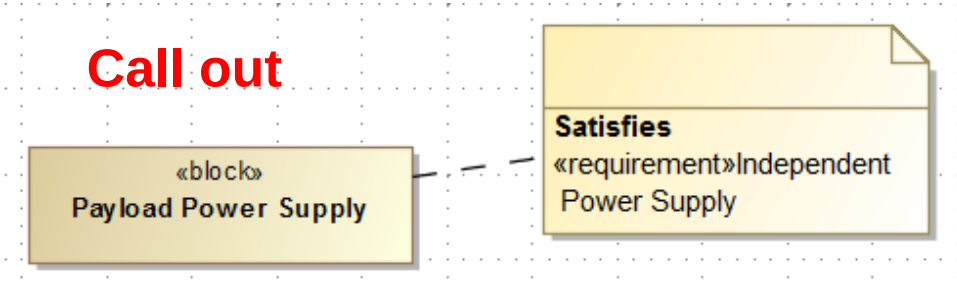
- Dependencies appear as dashed line arrows with a <<keyword>>



- Dependencies always point from dependent to independent party, client to supplier, result to cause …
- Dependencies may appear in alternate formats

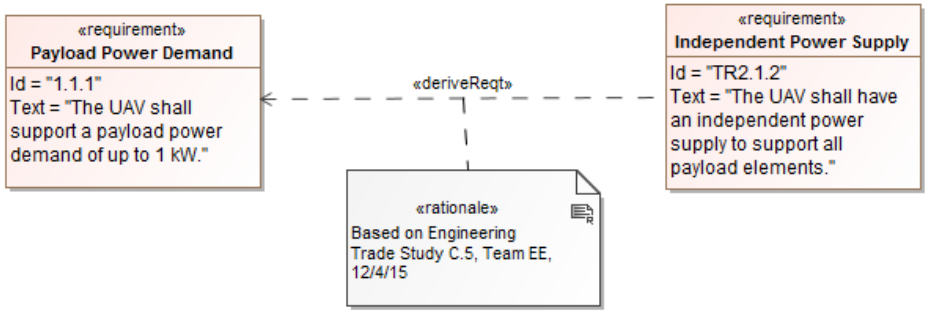


Compartments

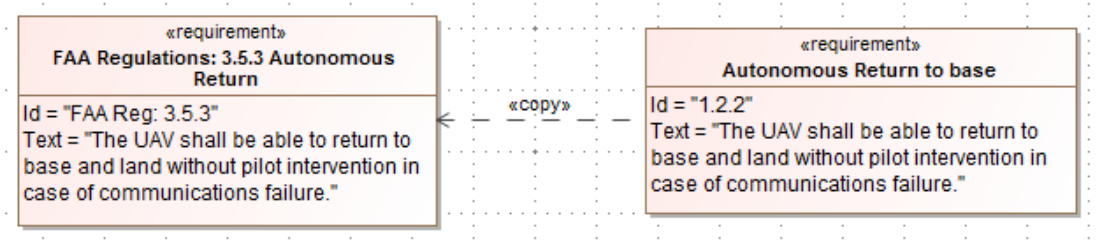


Derive and Copy

- Derive – identifies a requirement as having been derived from one or more other requirements

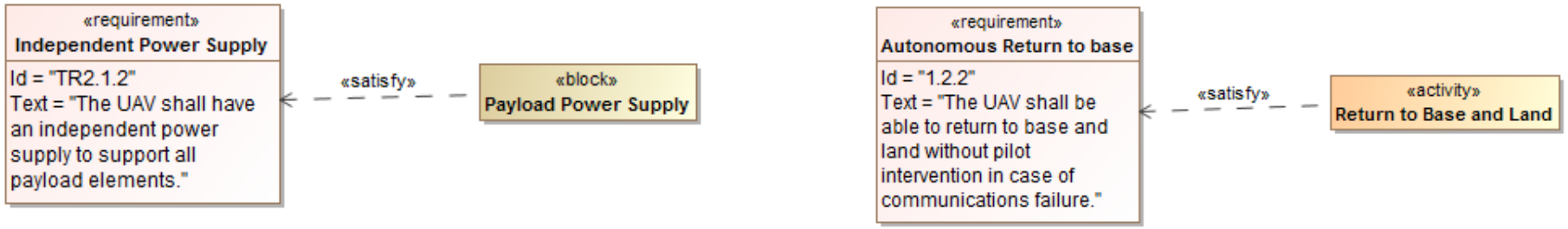


- Copy – identifies a project requirement as an exact copy of a standard or library requirement

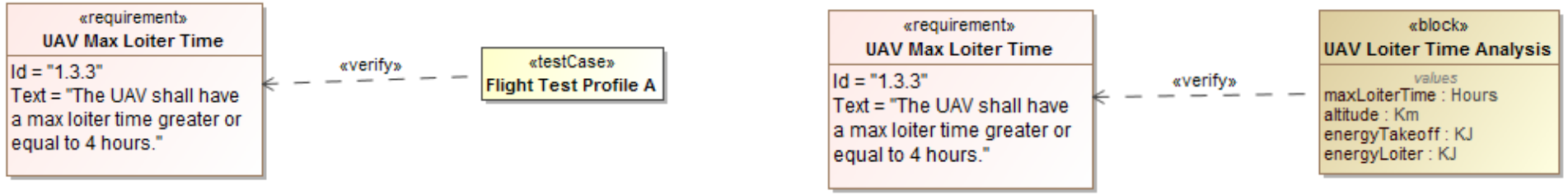


Satisfy and Verify

- Satisfy – assert that an element satisfies a requirement

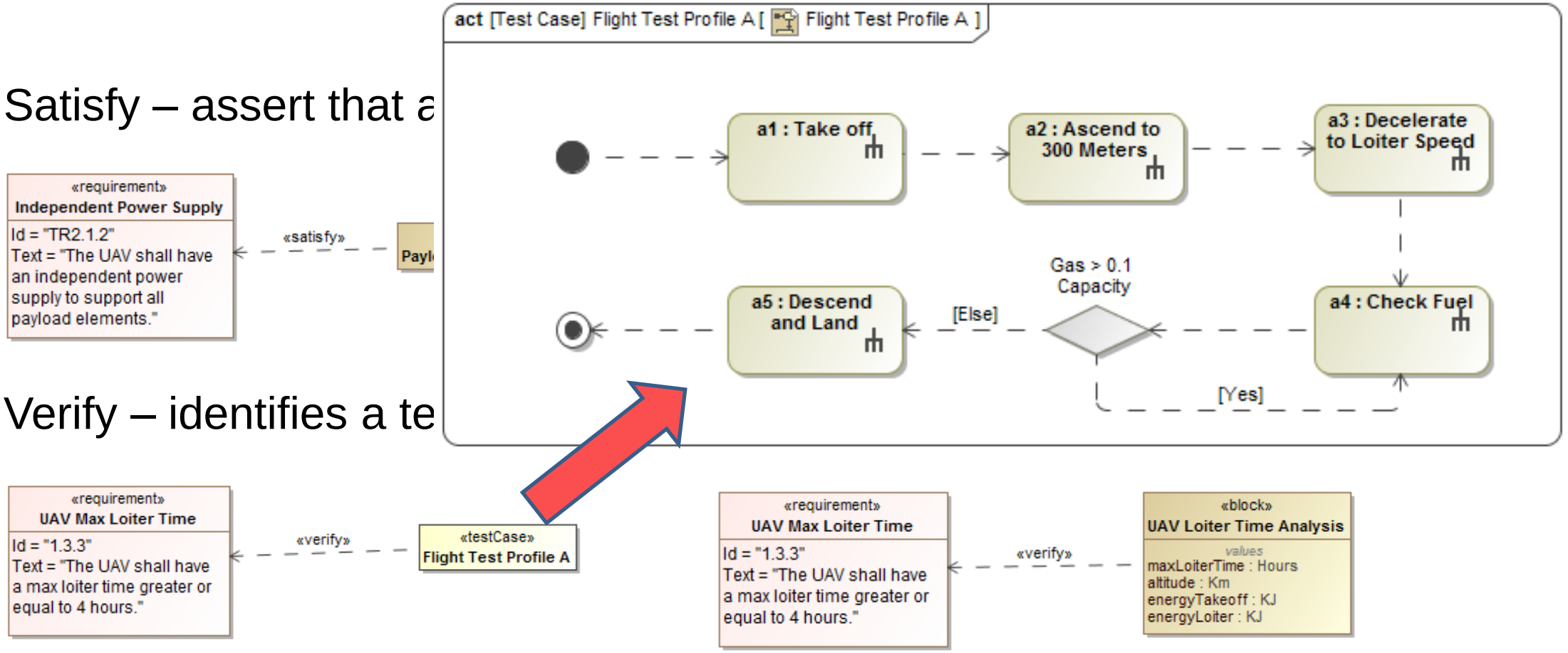


- Verify – identifies a testcase that can be used to verify a requirement



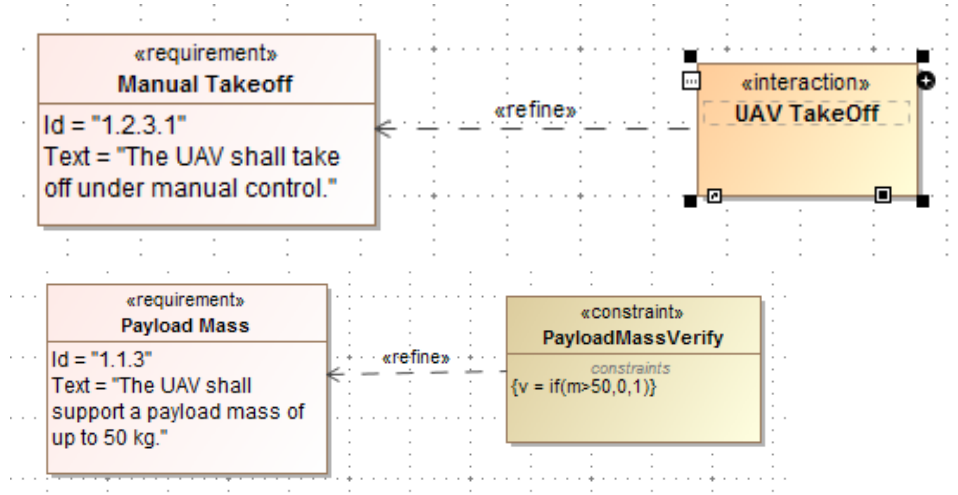
Satisfy and Verify

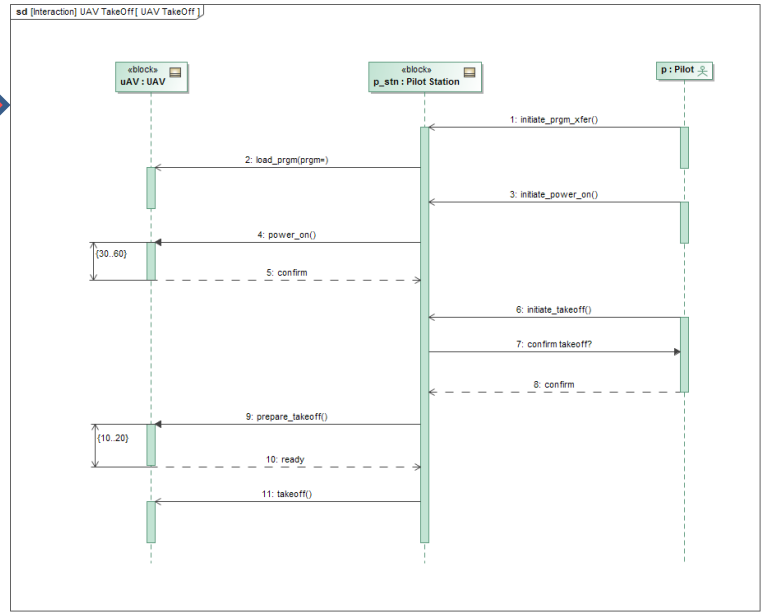
- Satisfy – assert that a
- Verify – identifies a te



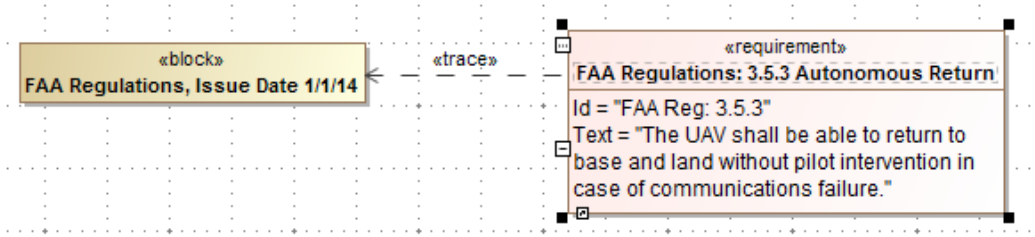
Refine and Trace

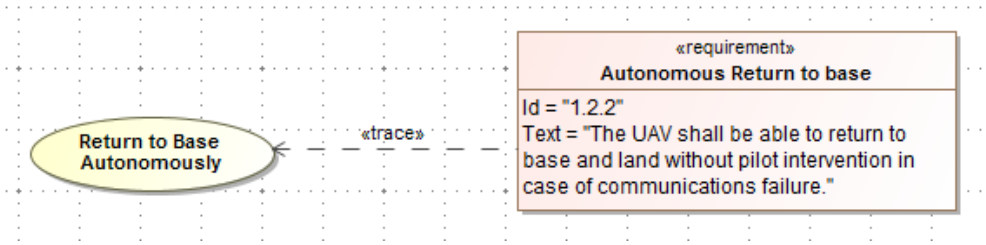
- Refine – clarify or add information to a requirement





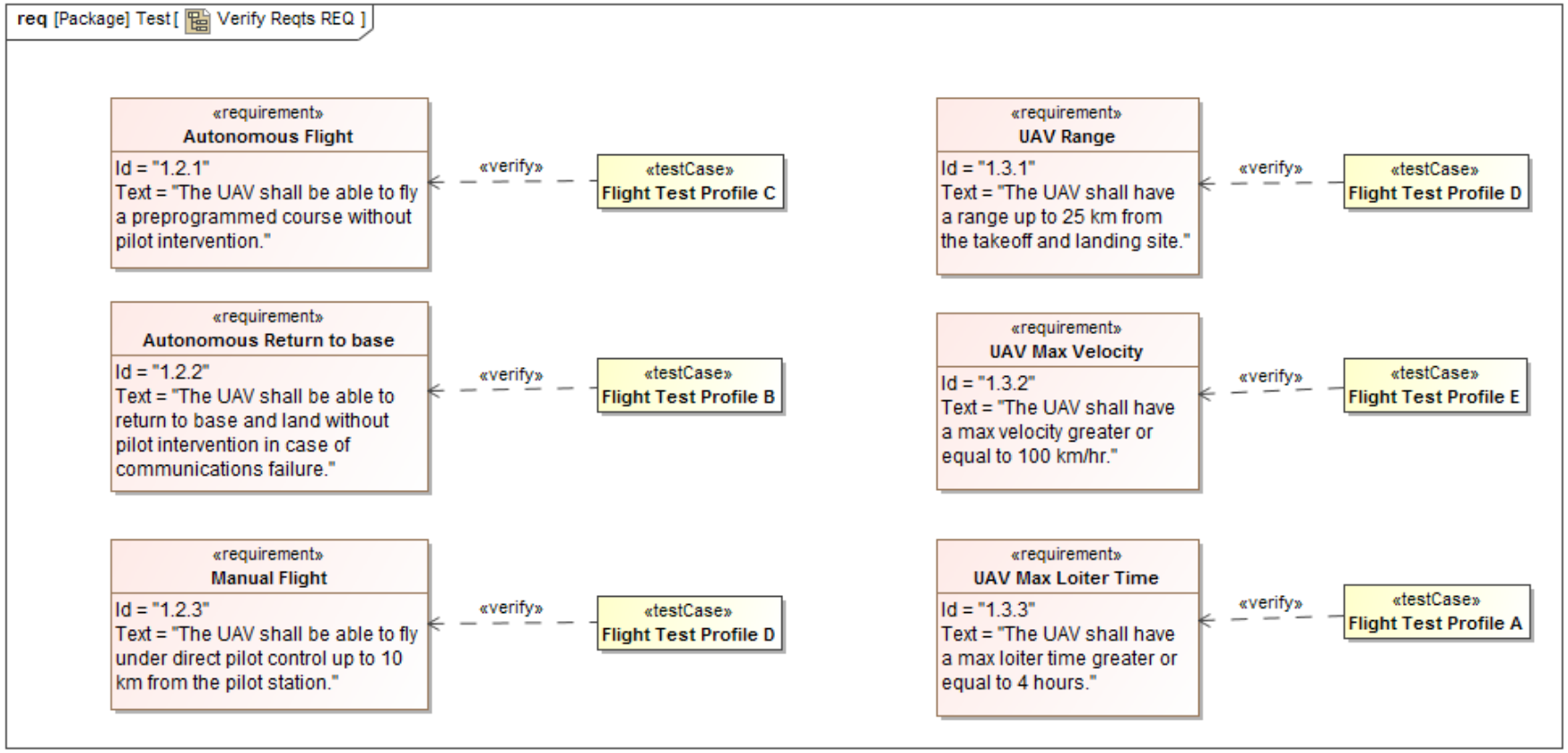
- Trace - provide a traceable link





Requirement Diagrams

- Second application – creating and displaying dependencies linking requirements to other elements



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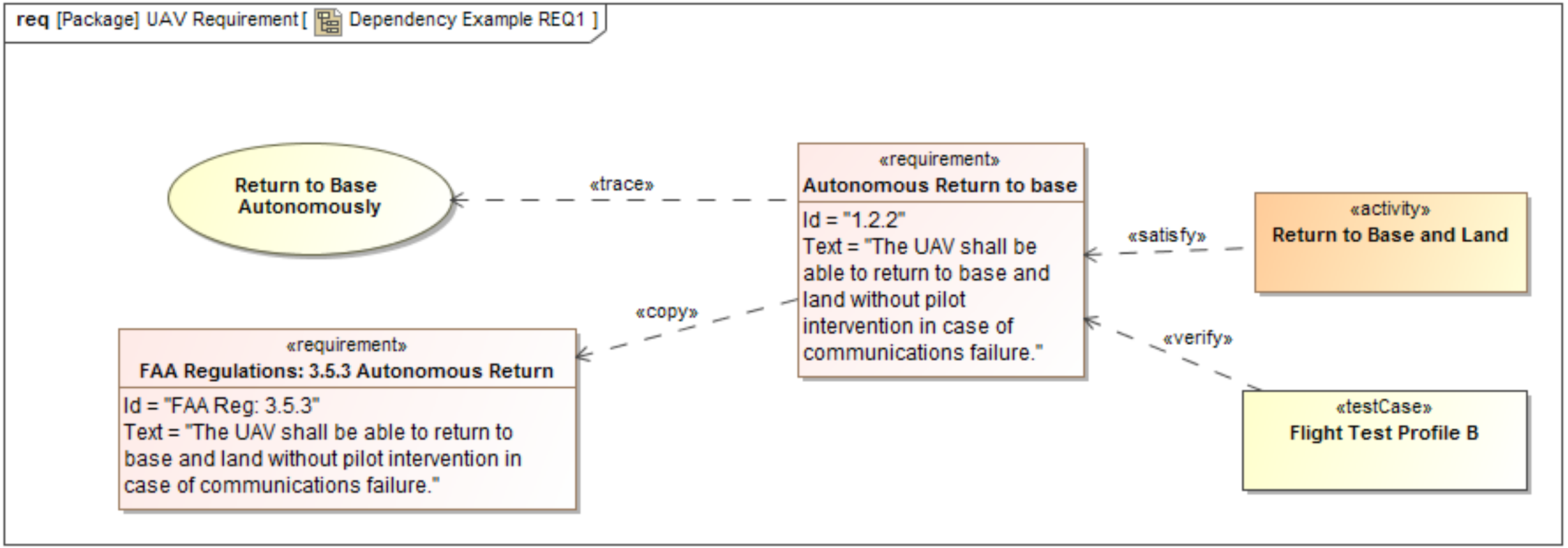
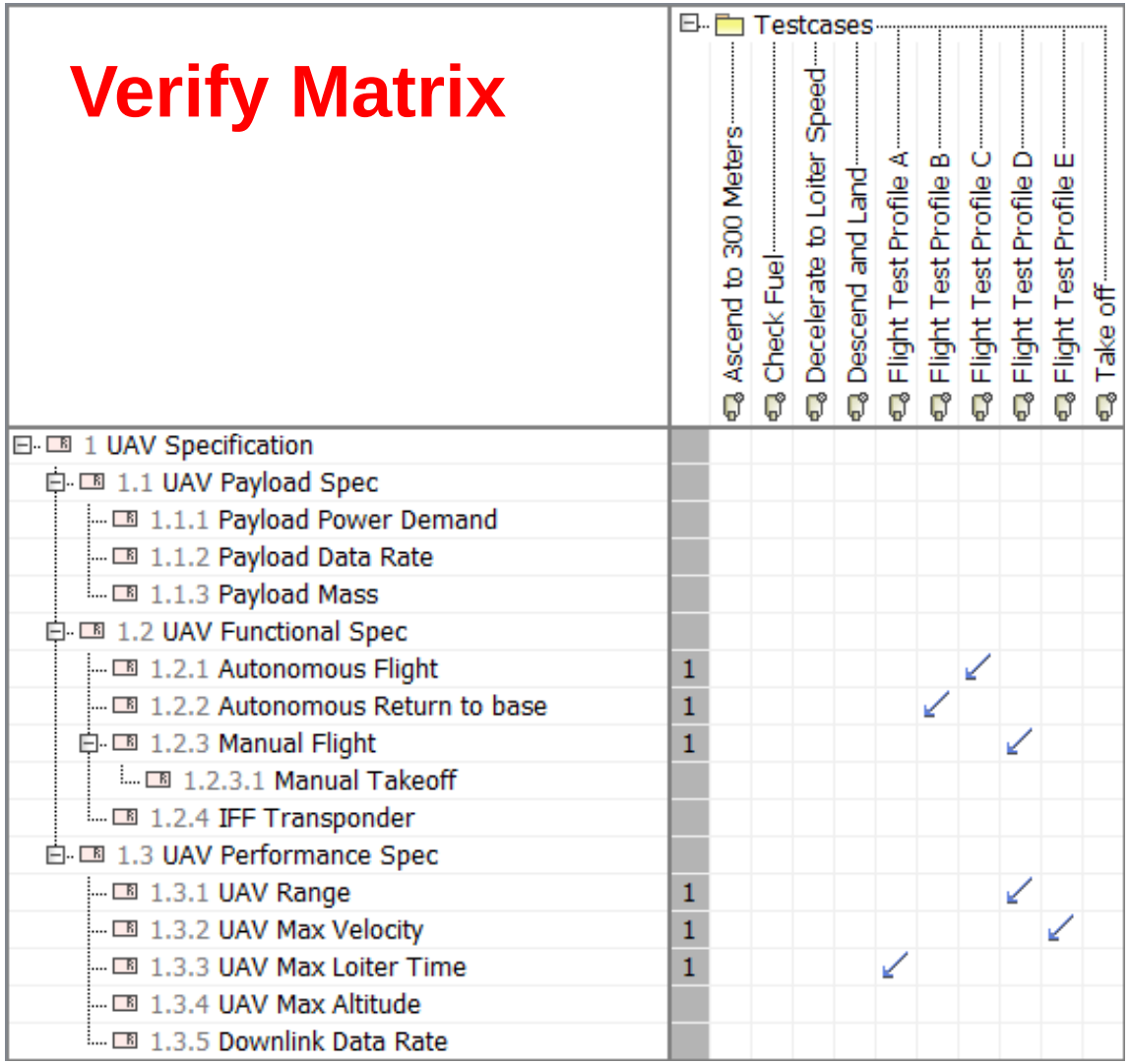


Requirement Tables

#	Id	Name	Text	Verified By
1	1.1.1	Payload Power Demand	The UAV shall support a payload power demand of up to 1 kW.	
2	1.1.2	Payload Data Rate	The UAV shall support a payload data rate out of up to 8 Mb/s.	
3	1.1.3	Payload Mass	The UAV shall support a payload mass of up to 50 kg.	
4	1.2.1	Autonomous Flight	The UAV shall be able to fly a preprogrammed course without pilot intervention.	Flight Test Profile C
5	1.2.2	Autonomous Return to base	The UAV shall be able to return to base and land without pilot intervention in case of communications failure.	Flight Test Profile B
6	1.2.3	Manual Flight	The UAV shall be able to fly under direct pilot control up to 10 km from the pilot station.	Flight Test Profile D
7	1.2.4	IFF Transponder	The UAV shall continuously broadcast an IFF signal to indicate location to other aircraft.	
8	1.3.1	UAV Range	The UAV shall have a range up to 25 km from the takeoff and landing site.	Flight Test Profile D
9	1.3.2	UAV Max Velocity	The UAV shall have a max velocity greater or equal to 100 km/hr.	Flight Test Profile E
10	1.3.3	UAV Max Loiter Time	The UAV shall have a max loiter time greater or equal to 4 hours.	UAV Loiter Time Analysis Flight Test Profile A
11	1.3.4	UAV Max Altitude	The UAV shall have a max operating altitude greater or equal to 1	
12	1.3.5	Downlink Data Rate	The UAV shall support downlink data rates up to 10 Mb/s.	

Requirement Matrices

Verify Matrix



First Exercise

- Create requirement table

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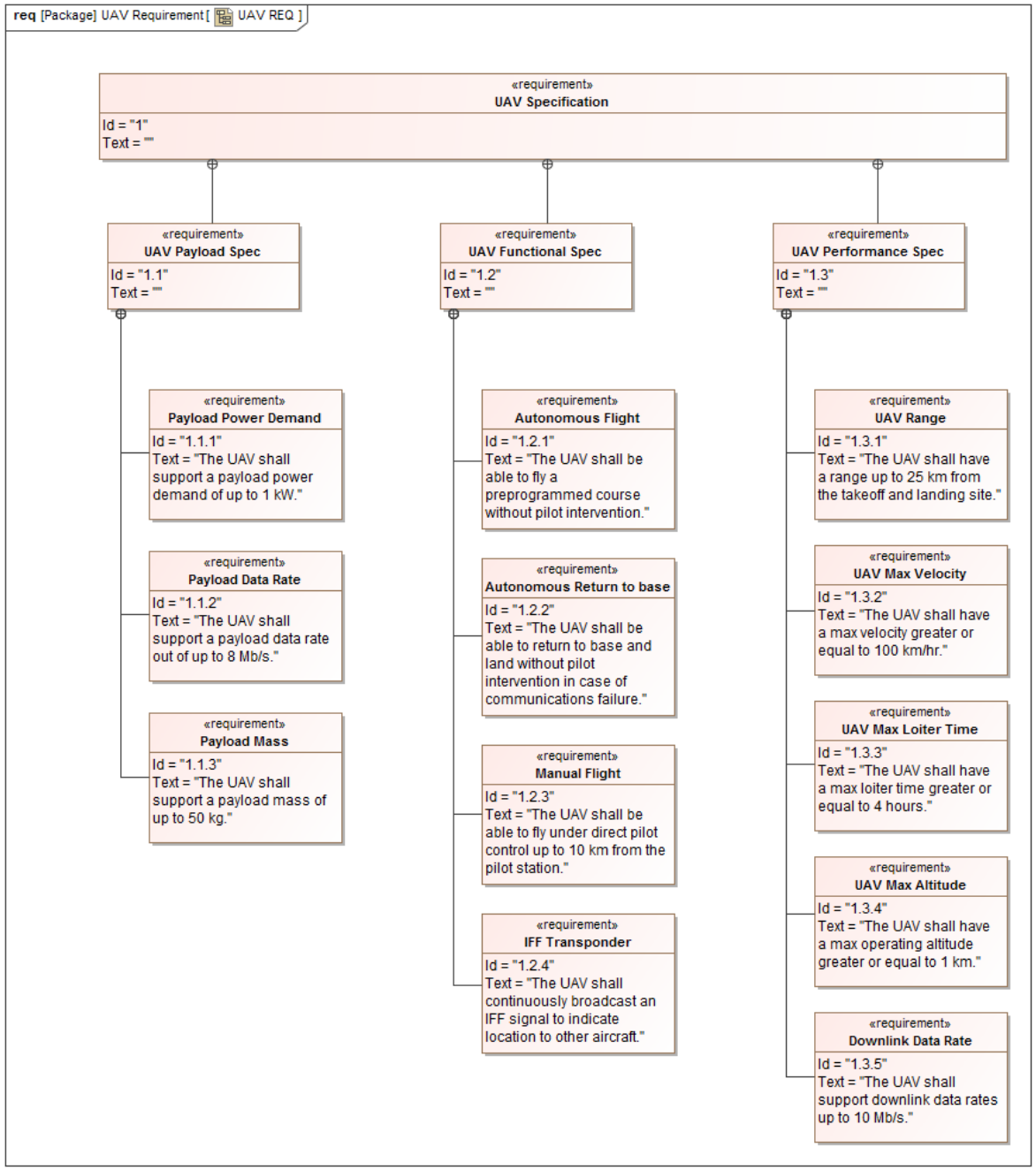
12	1.3.5	Downlink Data Rate	The UAV shall support downlink data rates up to 10 Mb/s.

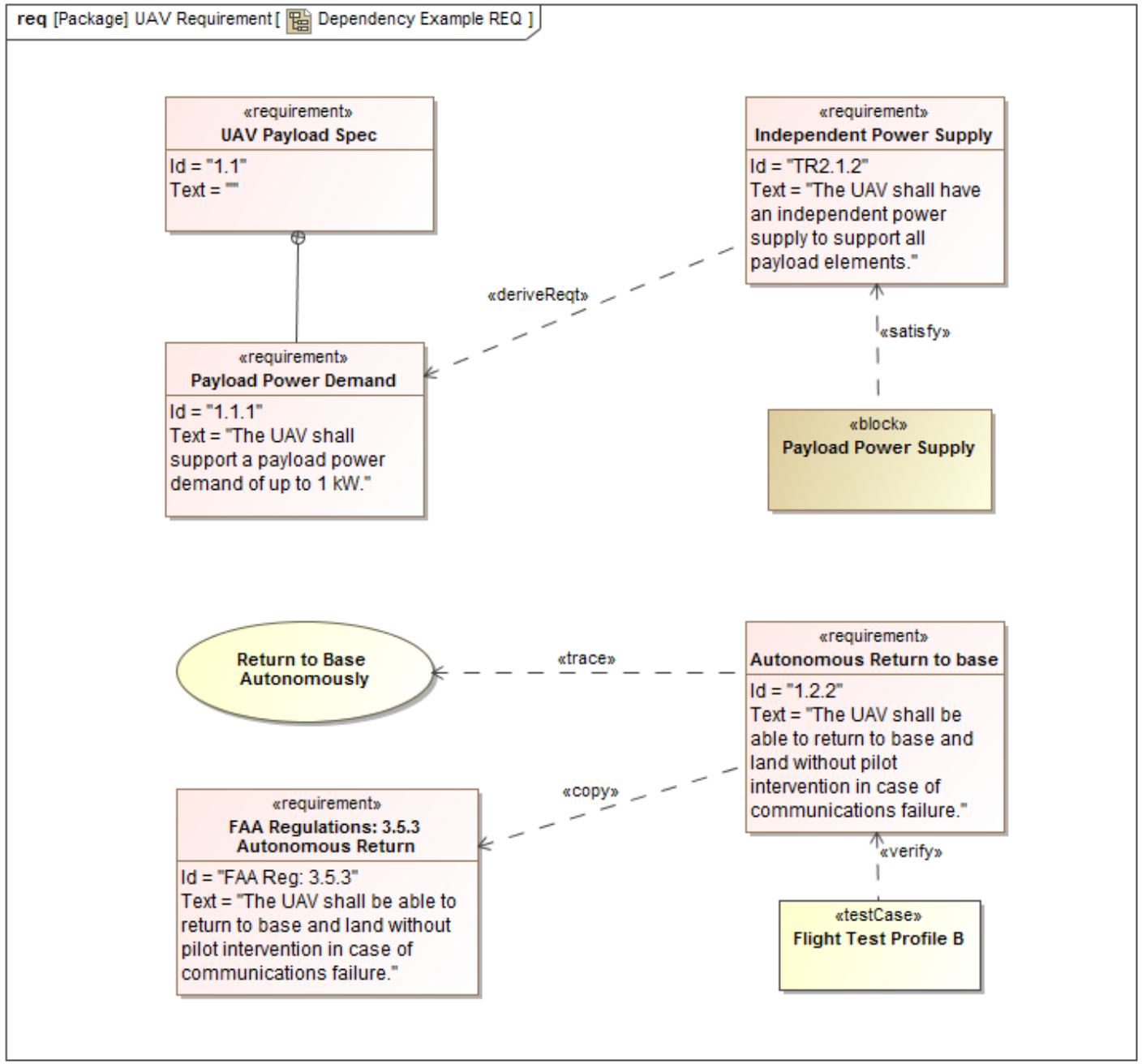
First Exercise

- Create requirement table
- Create requirement hierarchy in requirement diagram



First Exercise

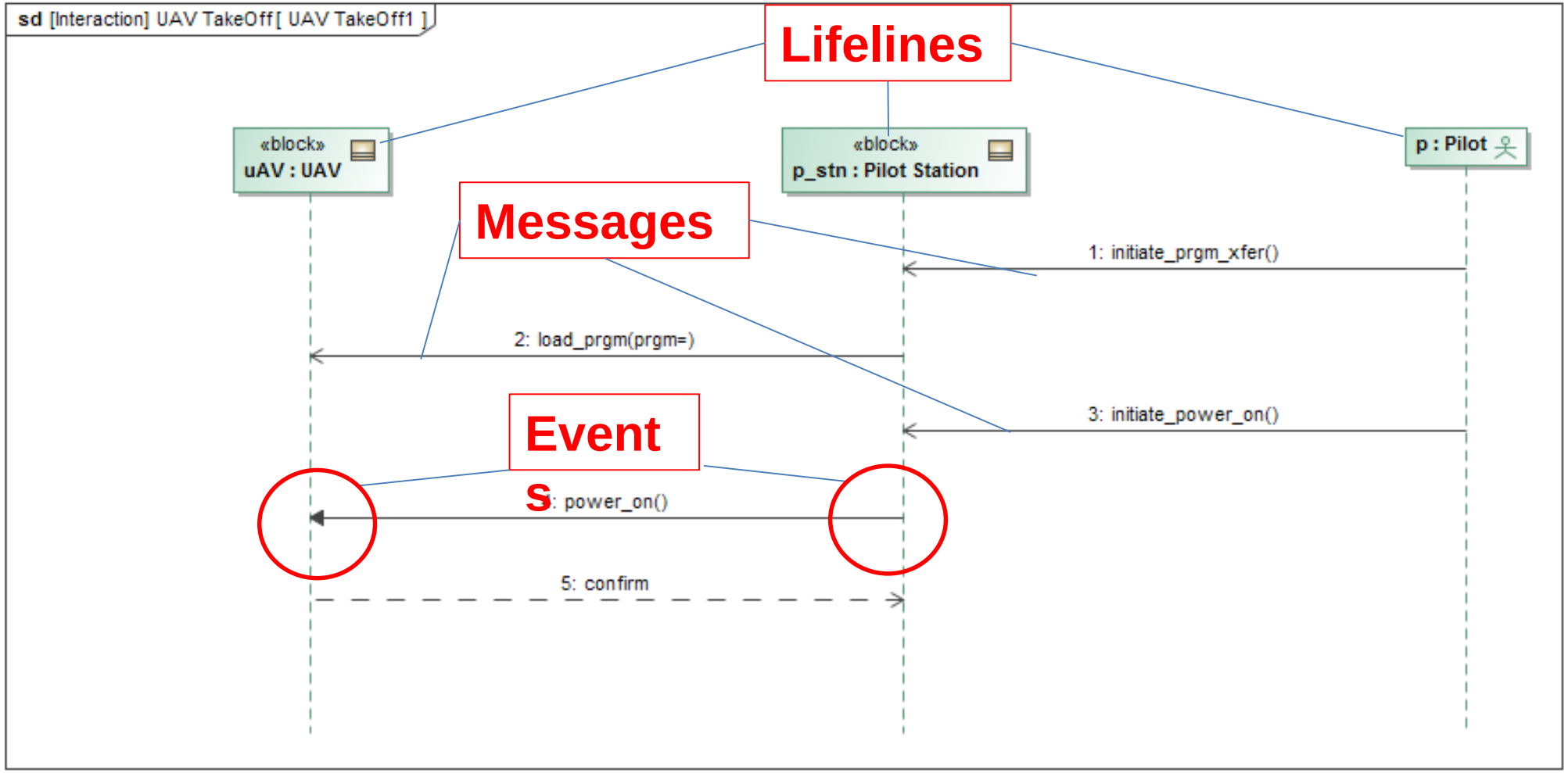
- Create requirement table
- Create requirement hierarchy in requirement diagram
- Create a variety of dependencies and display in a new requirement diagram



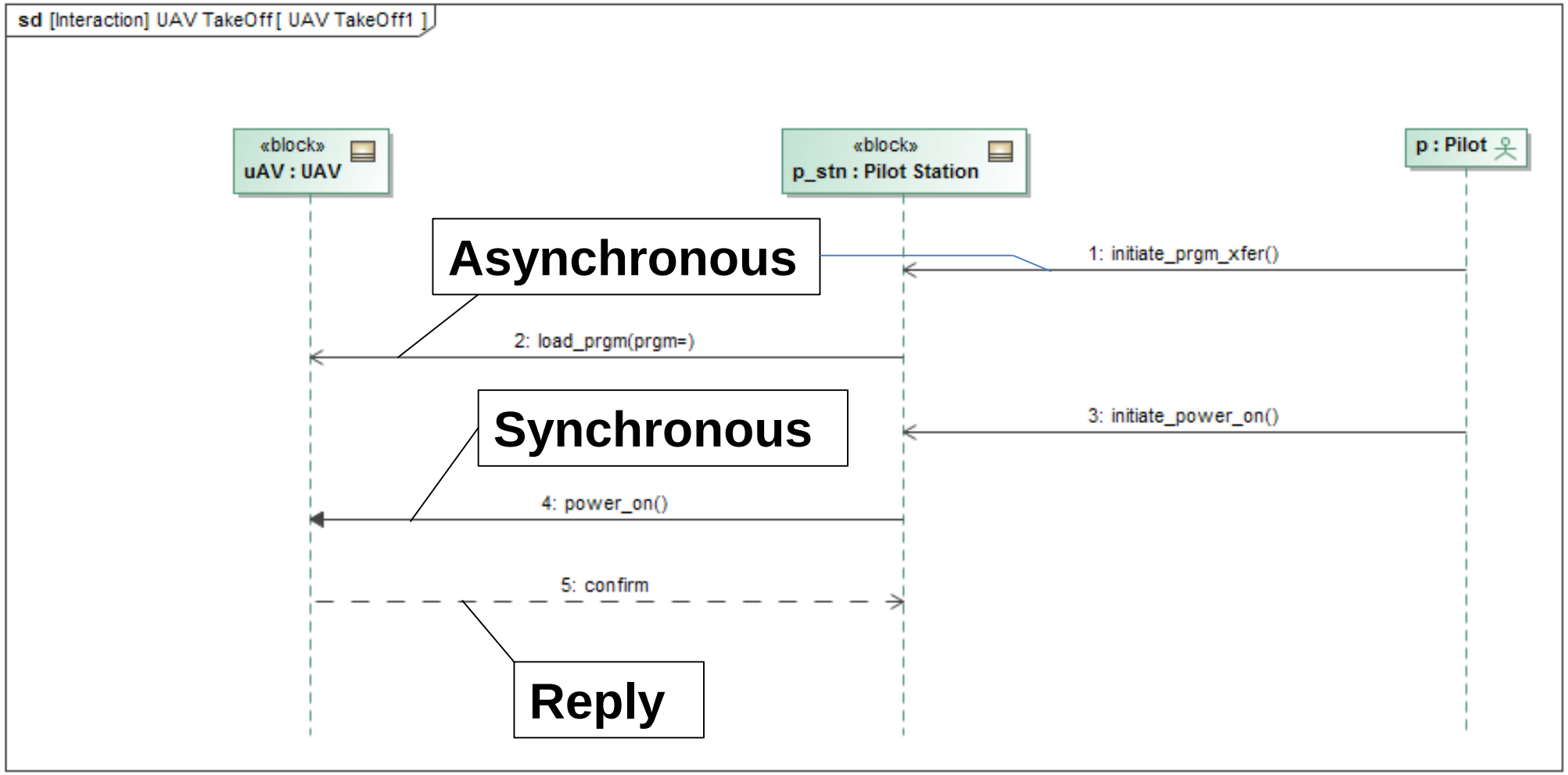
Interactions and Sequence Diagrams

- One common application of Sequence Diagrams is to capture scenarios at the concept-of-operations stage
- Interactions describe Message-Based Behavior
- A Sequence Diagram is a view of an Interaction
  - A Sequence Diagram always belongs to an Interaction.
- We will return to Interactions and Sequence Diagrams in Part 8, introducing more language concepts

Sequence Diagram



Sequence Diagram



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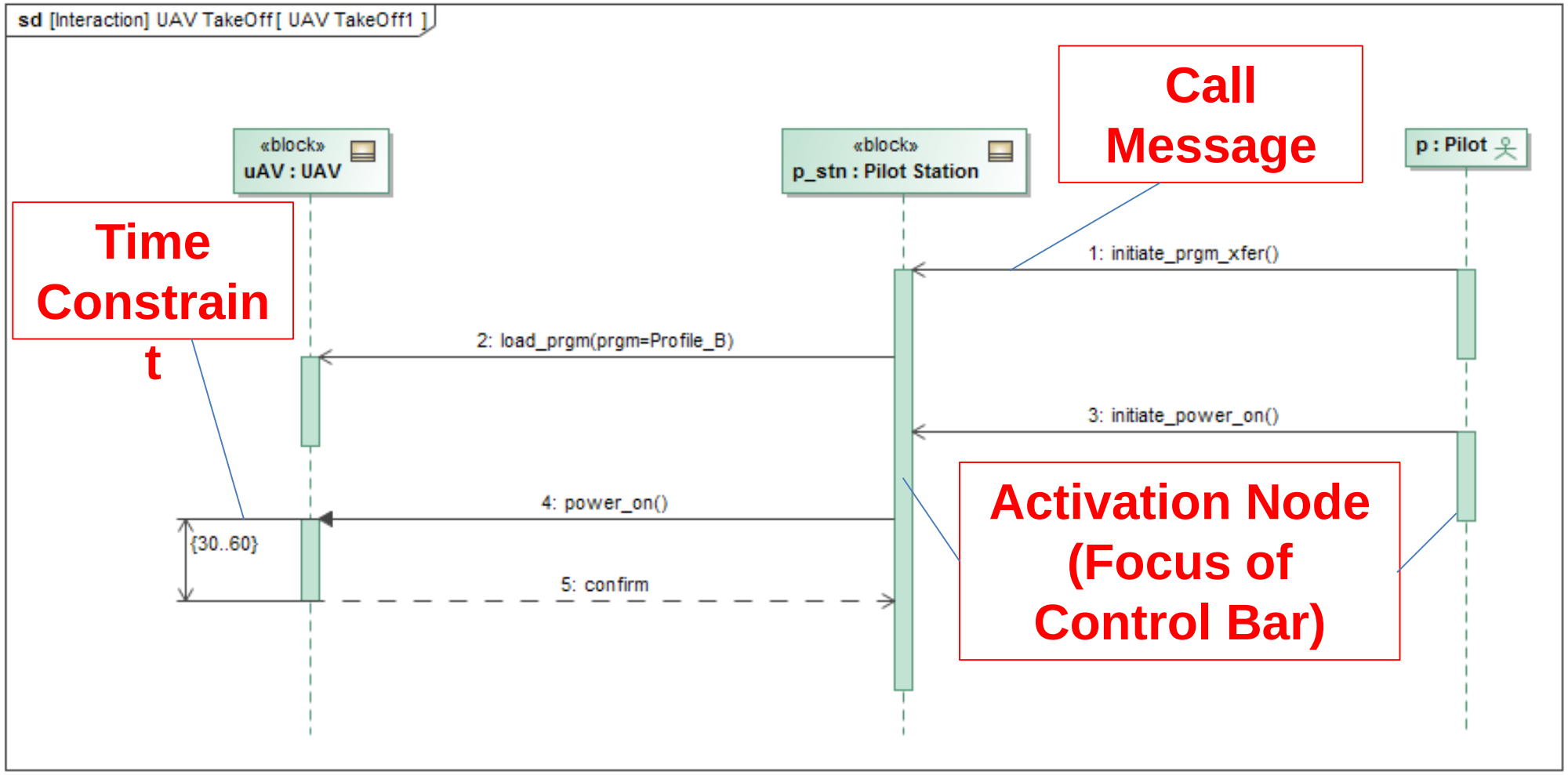

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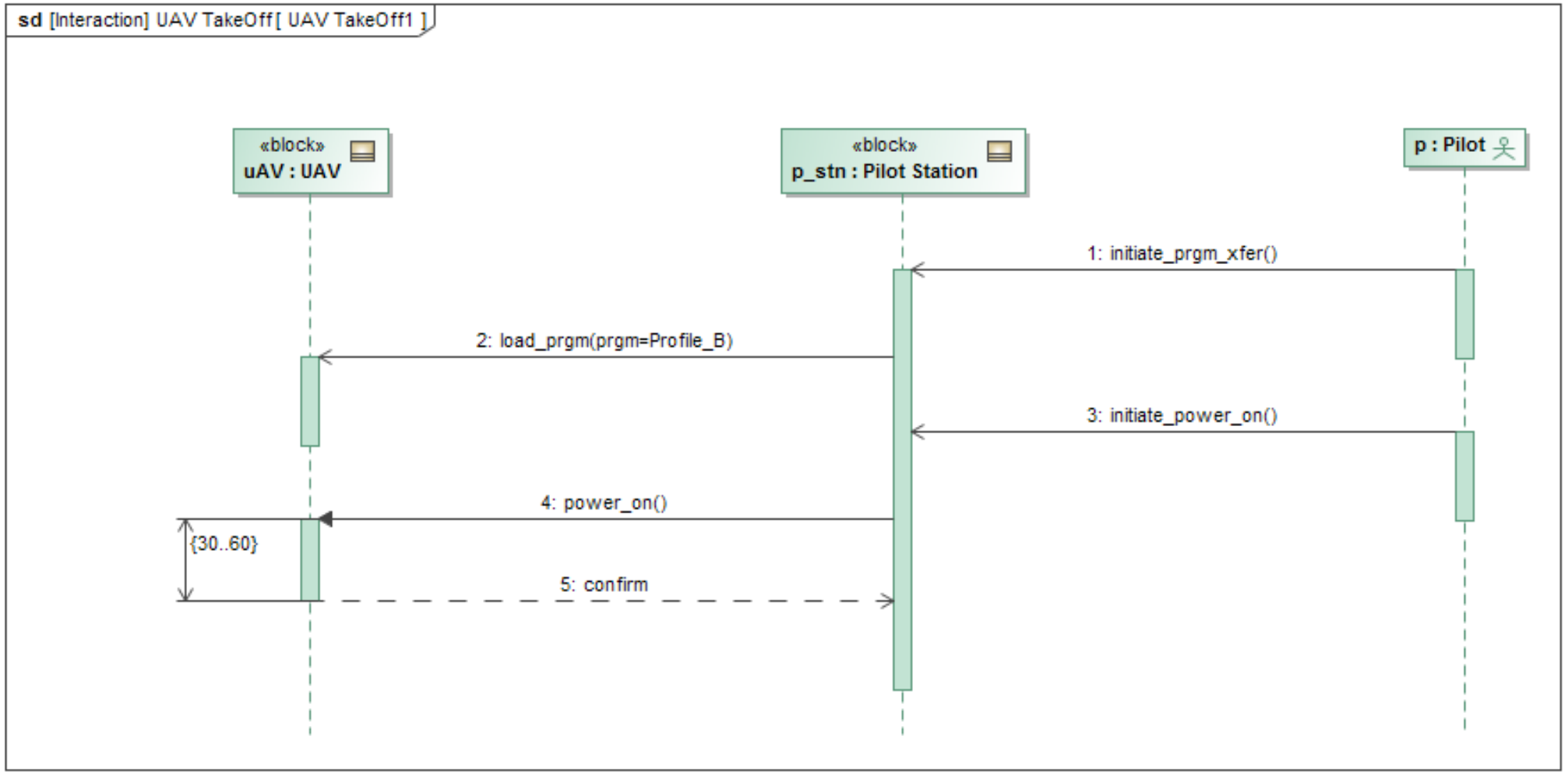
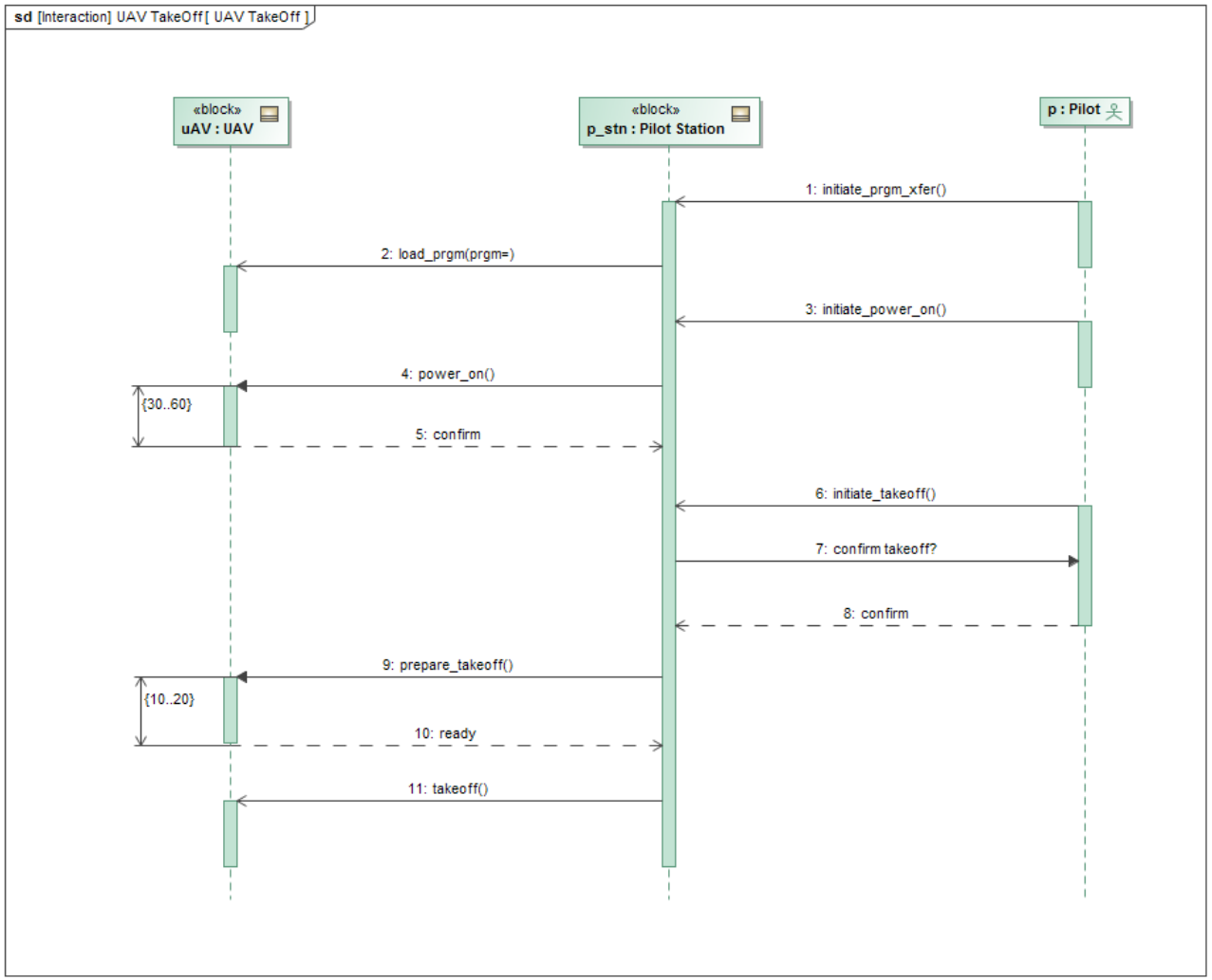


Second Exercise

- Create an Interaction and Sequence Diagram
- Populate diagram with Lifelines and Messages
- Add time constraints



Recap

- At the end of the hands-on exercises, you should be able to
  - Explain the following terms: requirement, satisfy, verify, refine, interaction, lifeline, message, event
  - Create a requirements hierarchy and display it in a requirement diagram
  - Explain the direction of a dependency arrow
  - Create an interaction with lifelines and messages and display it in a sequence diagram
  - Identify the principle purpose(s) of requirement and sequence diagrams

Questions?

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