The 6 Musketeers

COS 214 - Project Initial Design

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THE SIX MUSKETEERS

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Task 1.1: Functional Requirements

SpaceX:

•Optimise the cost of each launch depending on payload and requirements by choosing the best rocket configuration

Falcon 9:
- 1st stage: 1 x Falcon 9 core
  9 x Merlin engine
- 2nd stage: 1 x Vacuum Merlin engine

Falcon Heavy:
- 1st stage: 3 x Falcon 9 core
  27 x Merlin engine
- 2nd stage: 1 x Vacuum Merlin engine

•Each Rocket must be weighed
•The Crew Dragon transports Humans and Cargo to and from ISS
•The Dragon spacecraft only sends Cargo to ISS

Building an orbital class rocket:
•Test and Retest each rocket component

Launching an orbital class rocket:
•Perform 'static fire' test before each launch
•Launch
•Land first stage on a drone ship after launch (for reuse)

Starlink:

•Launched on a Falcon 9
•Falcon 9 transports Starlink satellites (up to 60)
•Once in orbit, satellites must spread out
•Satellites communicate with each other (by use of lasers)
•Satellites then communicate with users on the ground (by use of radio signals)

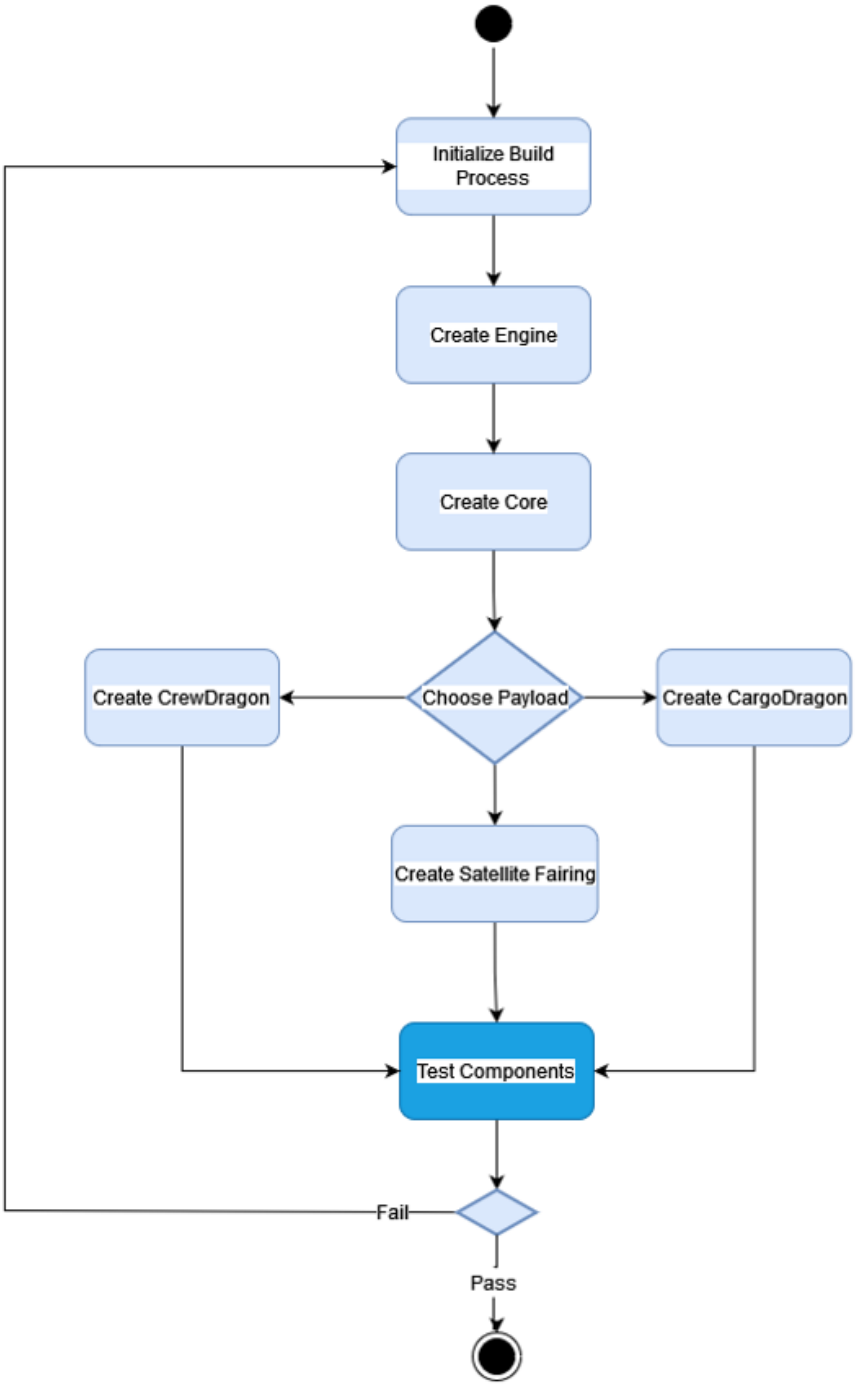
Launch Simulator:

•Provide an interface to setup simulations
•Test Mode Launch:
- Allow the interruption of the simulation
- Allow tweaking/altering of the simulation
- Allow the simulation to be relaunched/continued

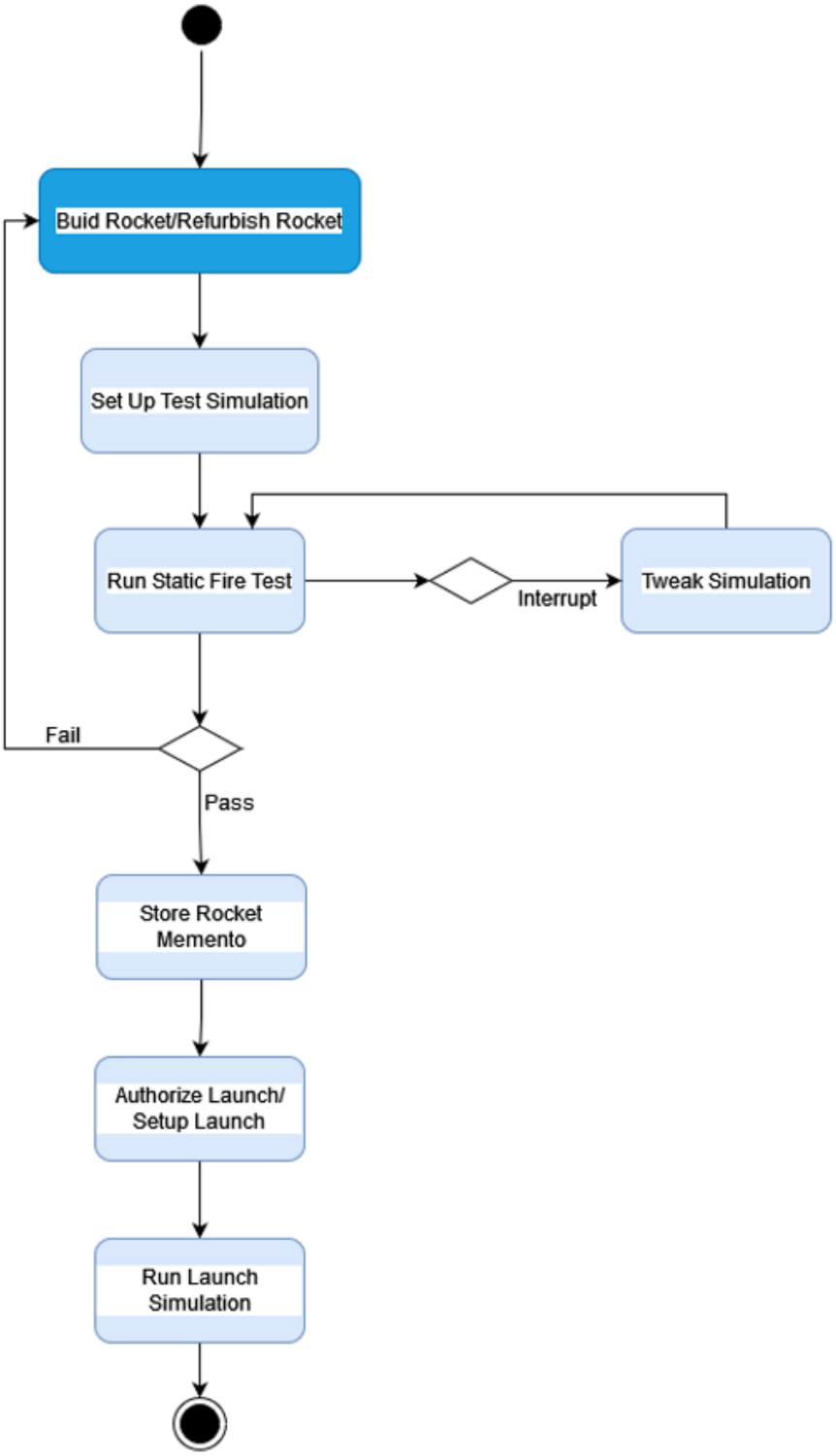
•Actual Launch:
- Can be stored and run in batches

Task 1.2: Activity diagrams

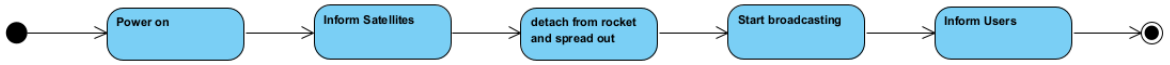
Construction Process



Testing and Simulation Process



Satellites in space



Task 1.3: Design patterns

Design Pattern	Description
Facade	Create a unified interface for the user
Decorator	Dragon capsule connection to rocket.
Composite	Individual parts of the rocket (engines, cores, ...) connect to the final rocket.
Observer	Users of Satellites (on the ground) observe changes to Satellites.
Mediator	Communication Network between Satellites.
Builder	Builds Rocket using Factory Methods.
Factory Method	Satellite Construction / Engine Construction / Core Construction
Prototype	Clone mementos to create batches of simulations
State	Starlink Satellite Orbit state, Dragon capsule Orbit/Dock/etc state, Flight Status (during simulation)
Memento	Store the rocket/simulation state

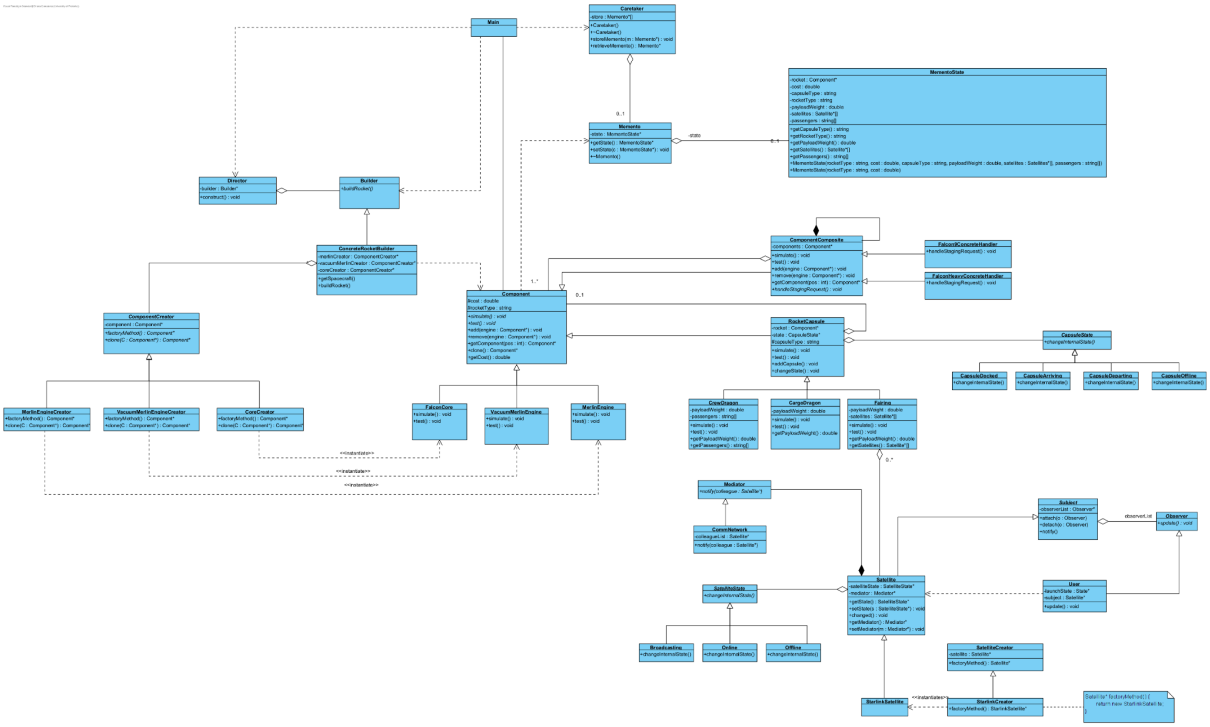
Task 1.4: Classes

Design pattern	**Participants**	**Class**
Facade	Facade	Facade
	Subsystem Classes	All other classes
Decorator	Component	Component
	ConcreteComponent	FalconCore
	Decorator	RocketCapsule
	ConcreteDecorator	CrewDragon, CargoDragon, Fairing
Composite	Component	Component
	Leaf	FalconCore
	Composite	ConcreteComposite
	Client	Main
Observer	Subject	Subject
	ConcreteSubject	Satellite
	Observer	Observer
	ConcreteObserver	User
Mediator	Mediator	Mediator
	ConcreteMediator	CommNetwork
	Colleagues	Satellite
Builder	Builder	Builder
	ConcreteBuilder	ConcreteRocketBuilder
	Director	Director
	Product	Component
Factory Method	Creator	ComponentCreator
	ConcreteCreator	MerlinEngineCreator, VacuumEngineCreator, CoreCreator

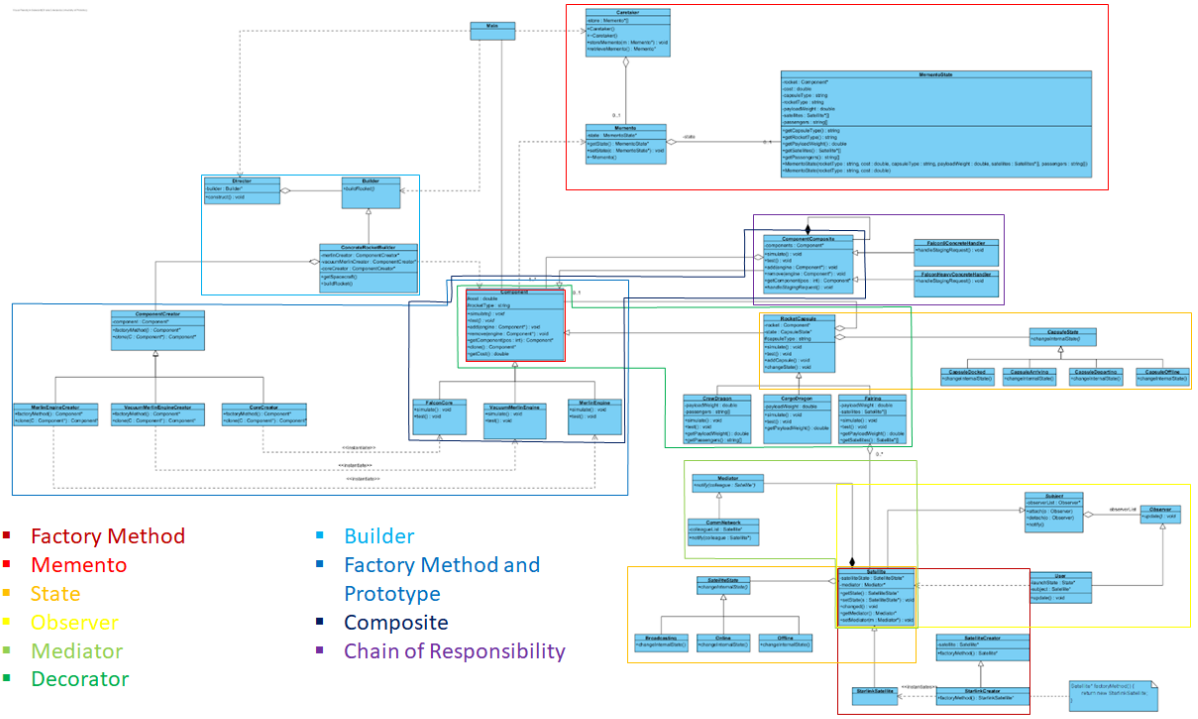
	Product	Component
	ConcreteProduct	FalconCore, VacuumMerlinEngine, MerlinEngine
Prototype	Prototype	Satellite
	ConcretePrototype	StarlinkSatellite
	Client	ConcreteRocketBuilder
State	State	SatelliteState, CapsuleState
	ConcreteState	Broadcasting, Online, Offline, CapsuleDocked, CapsuleArriving, CapsuleDeparting, CapsuleOffline
	Context	Satellite, RocketCapsule
Memento	Memento	Memento
	Originator	MementoState
	Caretaker	Caretaker

Task 1.5: Class Diagram

See attached pdf for full-size image



Class Diagram with the different design patterns highlighted

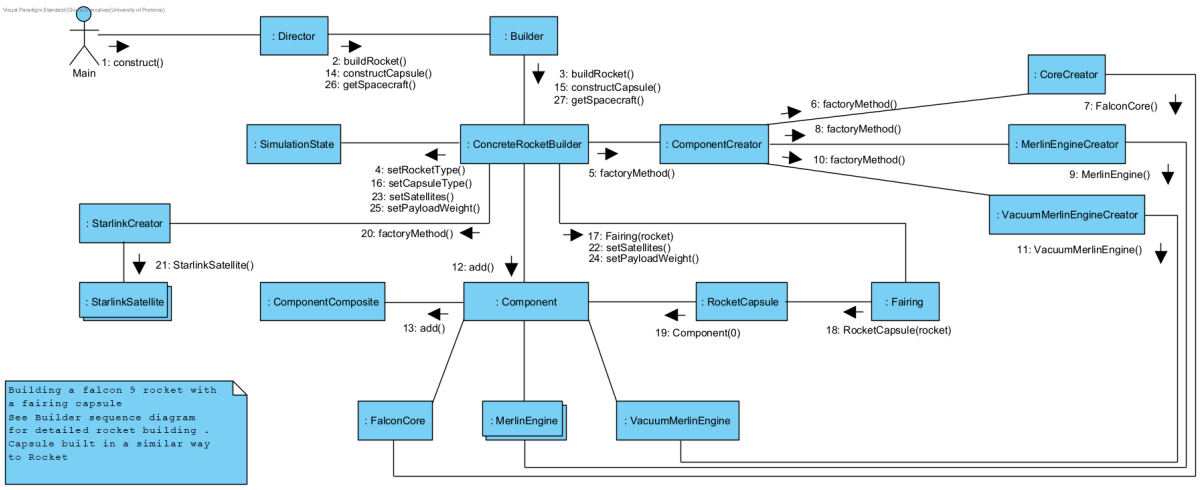


- Factory Method
- Memento
- State
- Observer
- Mediator
- Decorator
- Builder
- Factory Method and Prototype
- Composite
- Chain of Responsibility

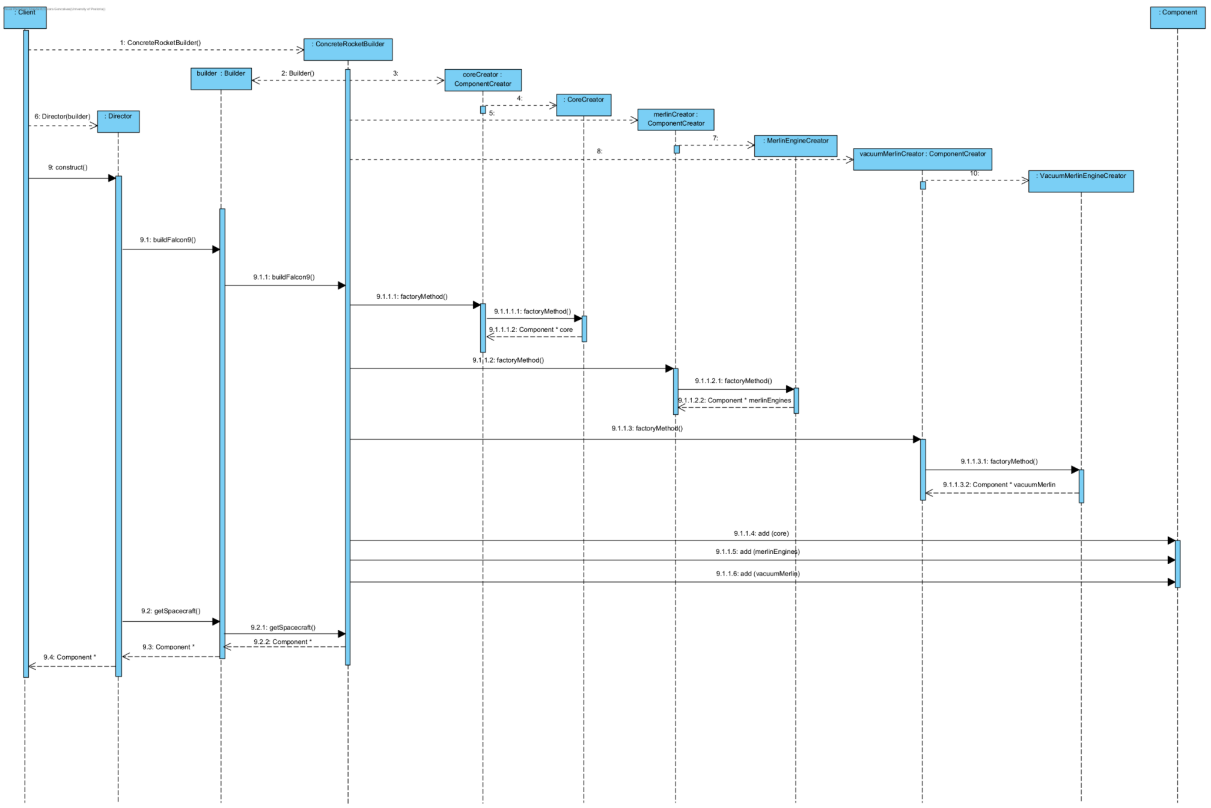
Task 1.6: Sequence and Communication Diagrams

See Diagrams/Task1.6 folder for pdf diagrams

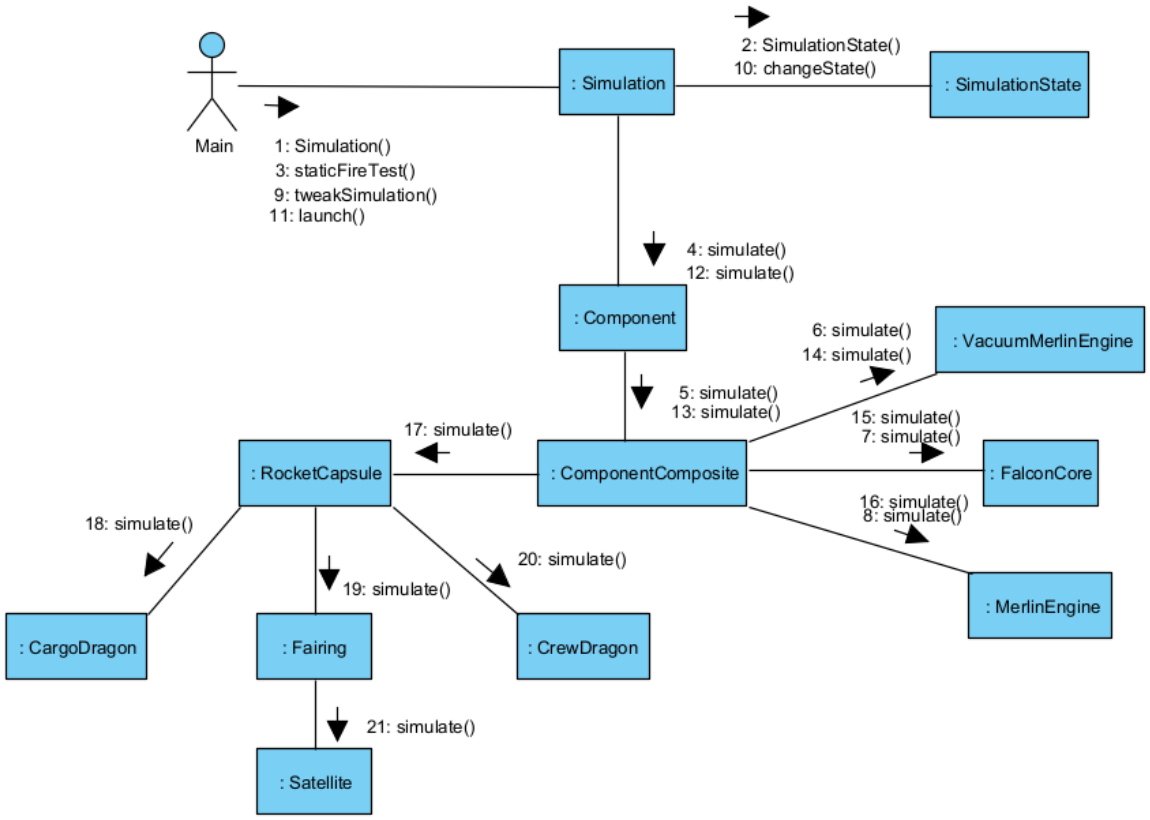
Building Rocket and Capsule - Communication



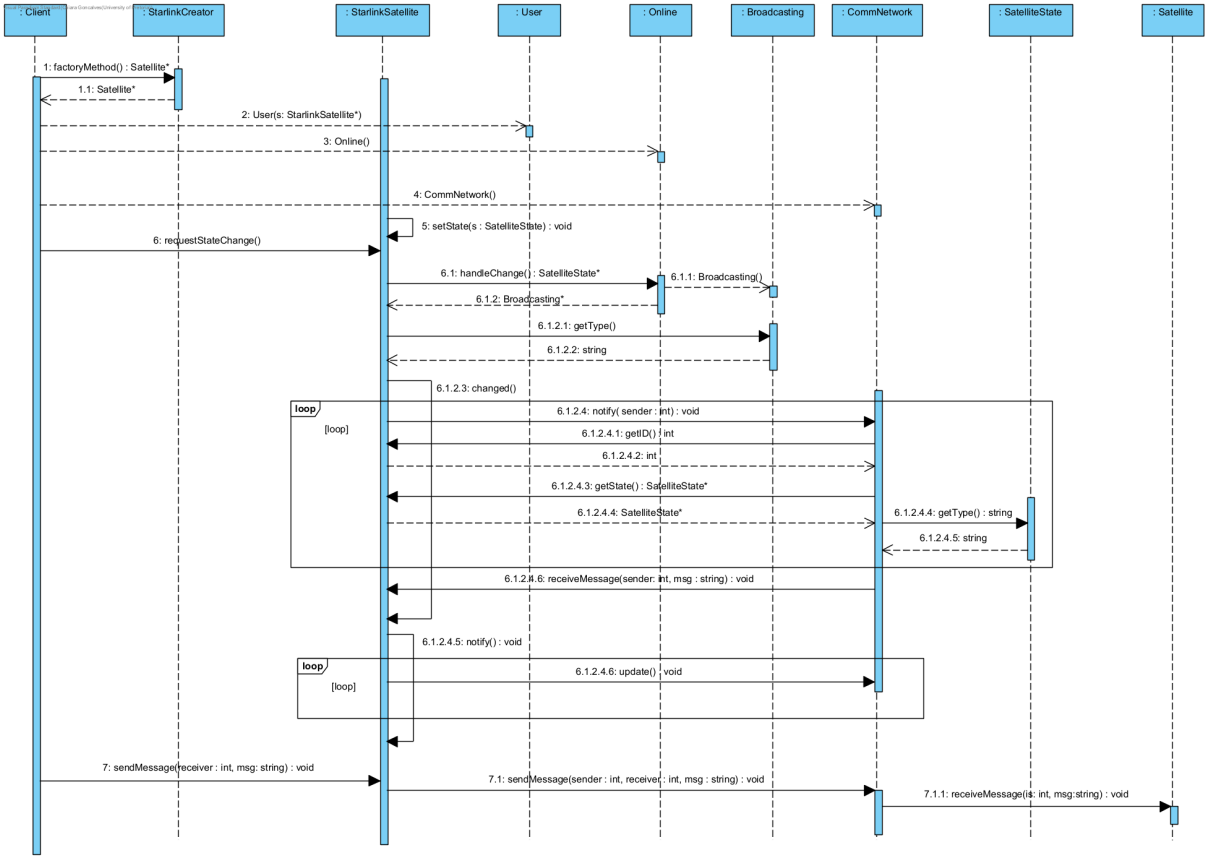
Building Rocket - Sequence Diagram



Launch - Communication

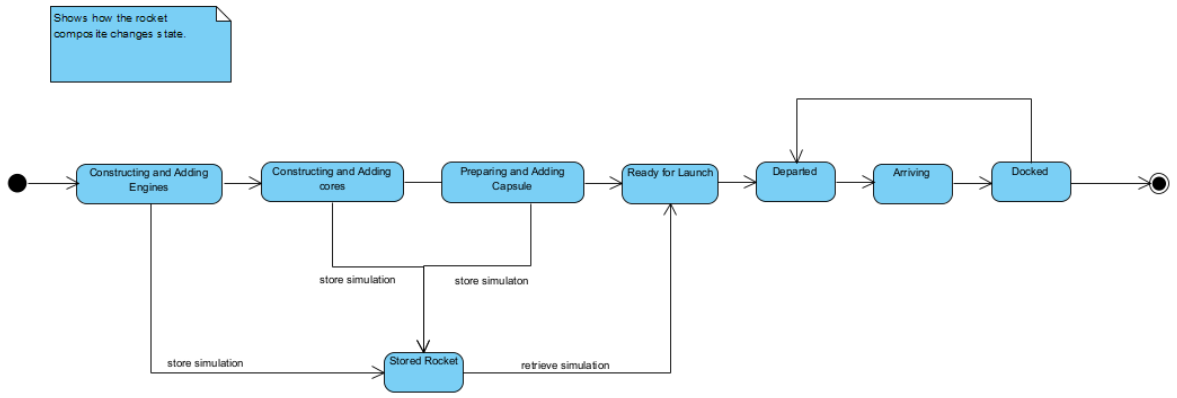


Satellite Communication - Sequence

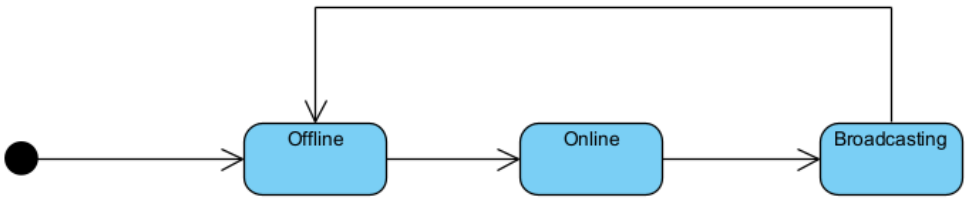


Task 1.7: State Diagrams

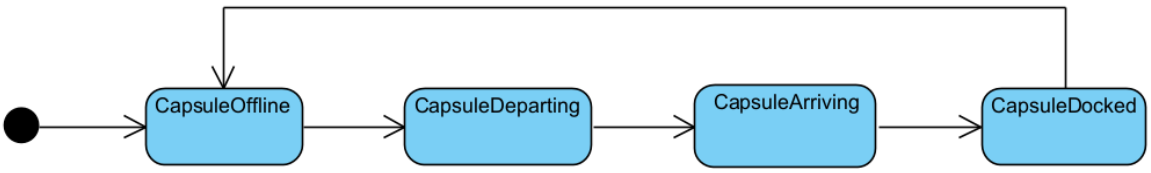
Rocket Composites state changes:



Satellite state changes:

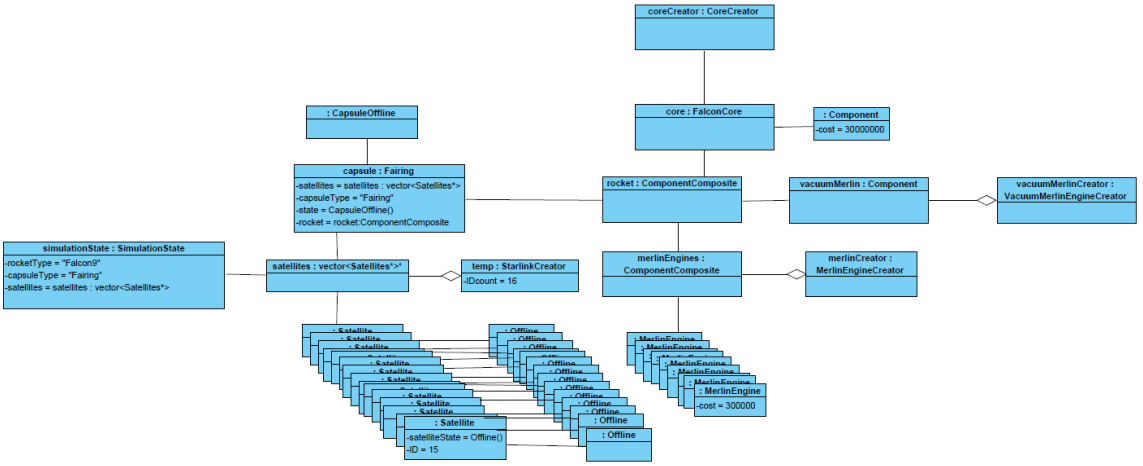


Capsule state changes:



Task 1.8: Object Diagrams

Before launch:



After launch: