myTaxiService

Software Engineering 2 -Project

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Outline

Outline

Actors

- Passenger
  - Registered passenger
  - Unregistered passenger
- Taxi driver
- Call center operator

Outline

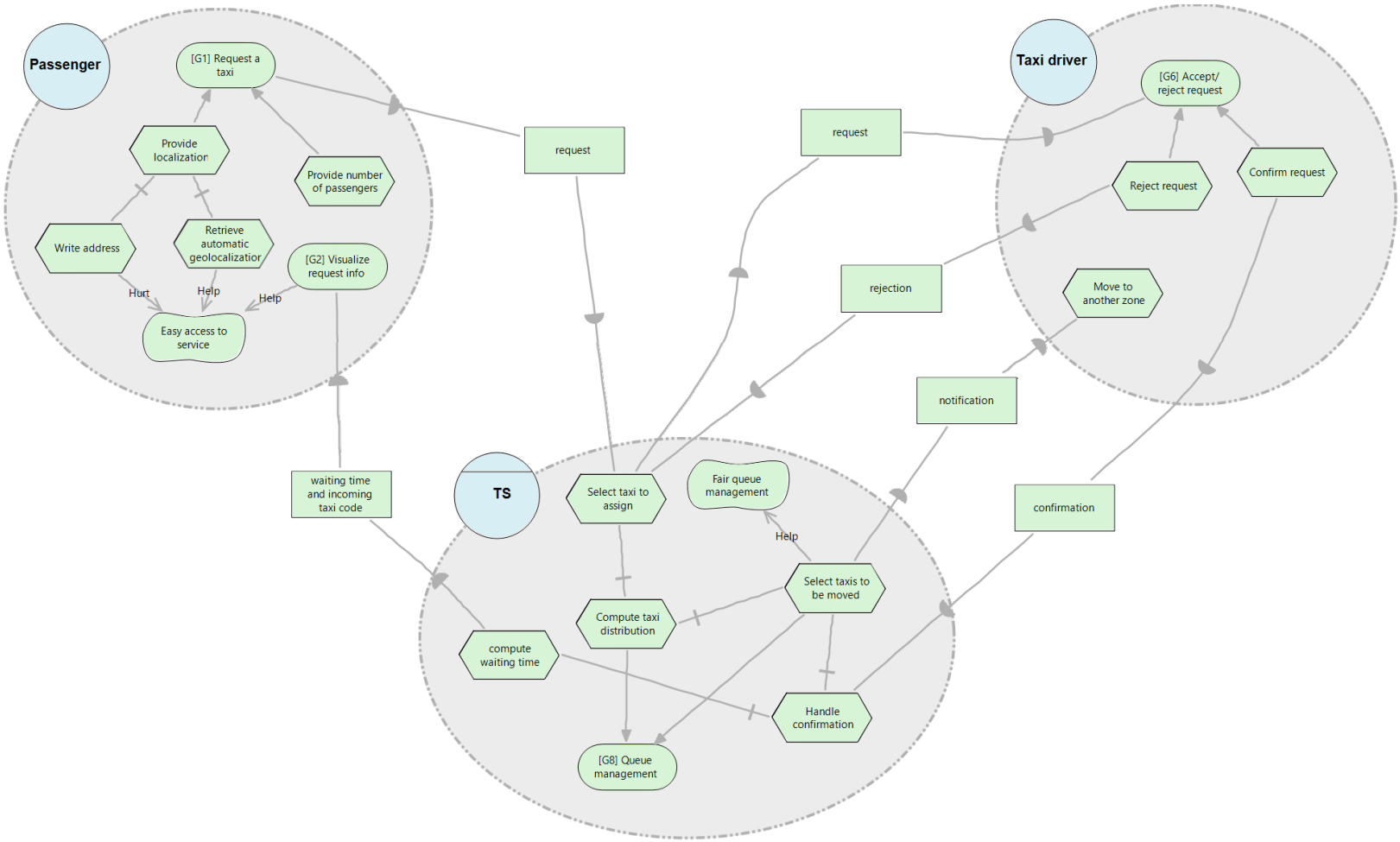
Goals
Jackson Zave approach - 1

- [G1] Allow a passenger to request a taxi for his/her current position without registration.
- [G2] Allow the passenger to visualize the waiting time and the code of the incoming taxi for confirmed requests.
- [G3] Allow a registered passenger to have a personal area.
- [G4] Allow a registered passenger to reserve a taxi.

Goals
Jackson Zave approach - 2

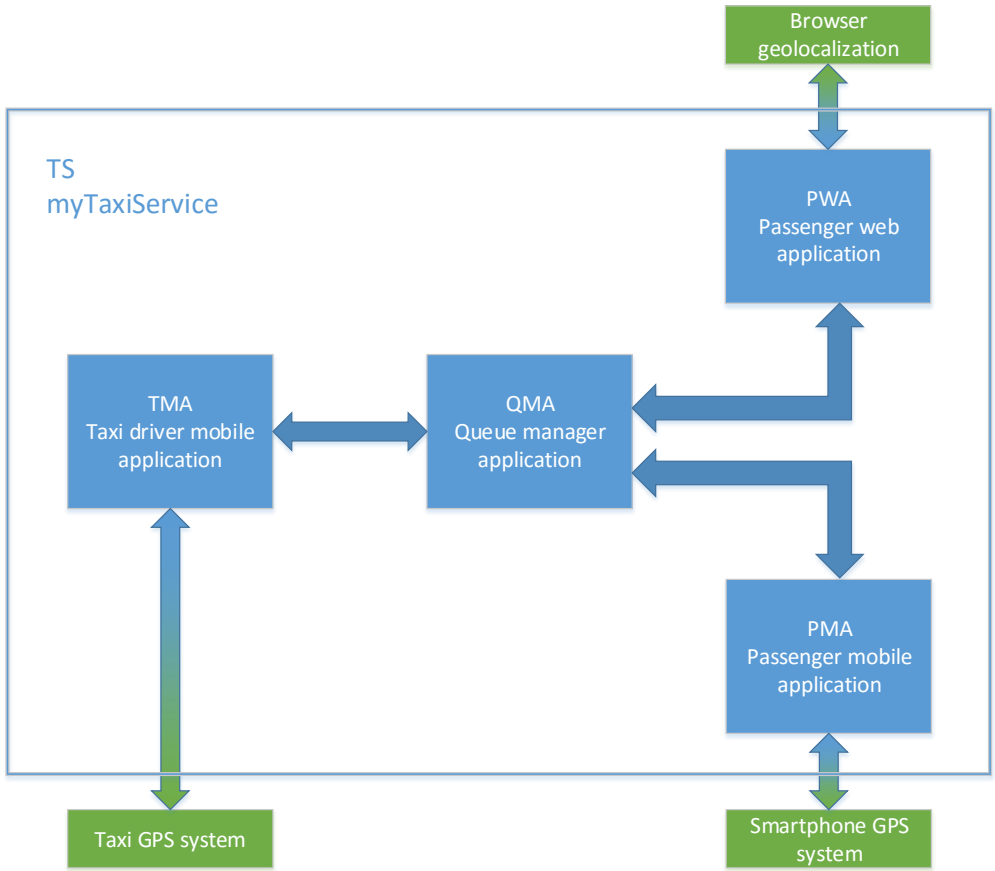
- [G5] Allow a registered passenger to cancel or modify a previous reservation.
- [G6] Allow a taxi driver to either accept or reject a request coming from the system.
- [G7] Allow a taxi driver to inform the system about his/her availability.
- [G8] Ensure that available taxi queues enjoy "fair properties" specified in sub paragraph 1.6.2.

i* model


Passenger
[G1] Request a taxi
Provide localization
Provide number of passengers
Write address
Retrieve automatic geolocalization
[G2] Visualize request info
Hurt
Help
Help
Easy access to service
request
request
Taxi driver
[G6] Accept/ reject request
Reject request
Confirm request
rejection
Move to another zone
notification
confirmation
waiting time and incoming taxi code
TS
Select taxi to assign
Fair queue management
Help
Select taxis to be moved
Compute taxi distribution
compute waiting time
Handle confirmation
[G8] Queue management

Outline

Product perspective
Conceptual system decomposition



Product perspective
Interoperability

- Integration with the previous taxi management system based on phone calls
- APIs to allow programmers to access the main functionalities for future requirements extensions

Outline

Functional requirements

Request - 1

- **[G1] Allow a passenger to request a taxi for his/her current position without registration.**
- [R1.1] TS shall provide the passenger with a form in which he/she has to insert the total number of passengers and accept terms and conditions.
- [R1.2] TS shall retrieve automatically passenger's position if GPS or browser geolocalization is available, otherwise user has to specify his/her address.

Functional requirements

Request - 2

- **[G1] Allow a passenger to request a taxi for his/her current position without registration.**
- [R1.3] After confirmation, TS shall store the request and
  - [R.1.3.1] Assign it to the first available taxi in the queue of the zone.
  - [R.1.3.2] If the queue is empty, TS shall look for taxis in the queues of adjacent zones and, if necessary, repeat the process for the other adjacent zones.
  - [R.1.3.3] If no taxi is found, TS shall inform passenger and put request on hold.

Functional requirements
Reservation

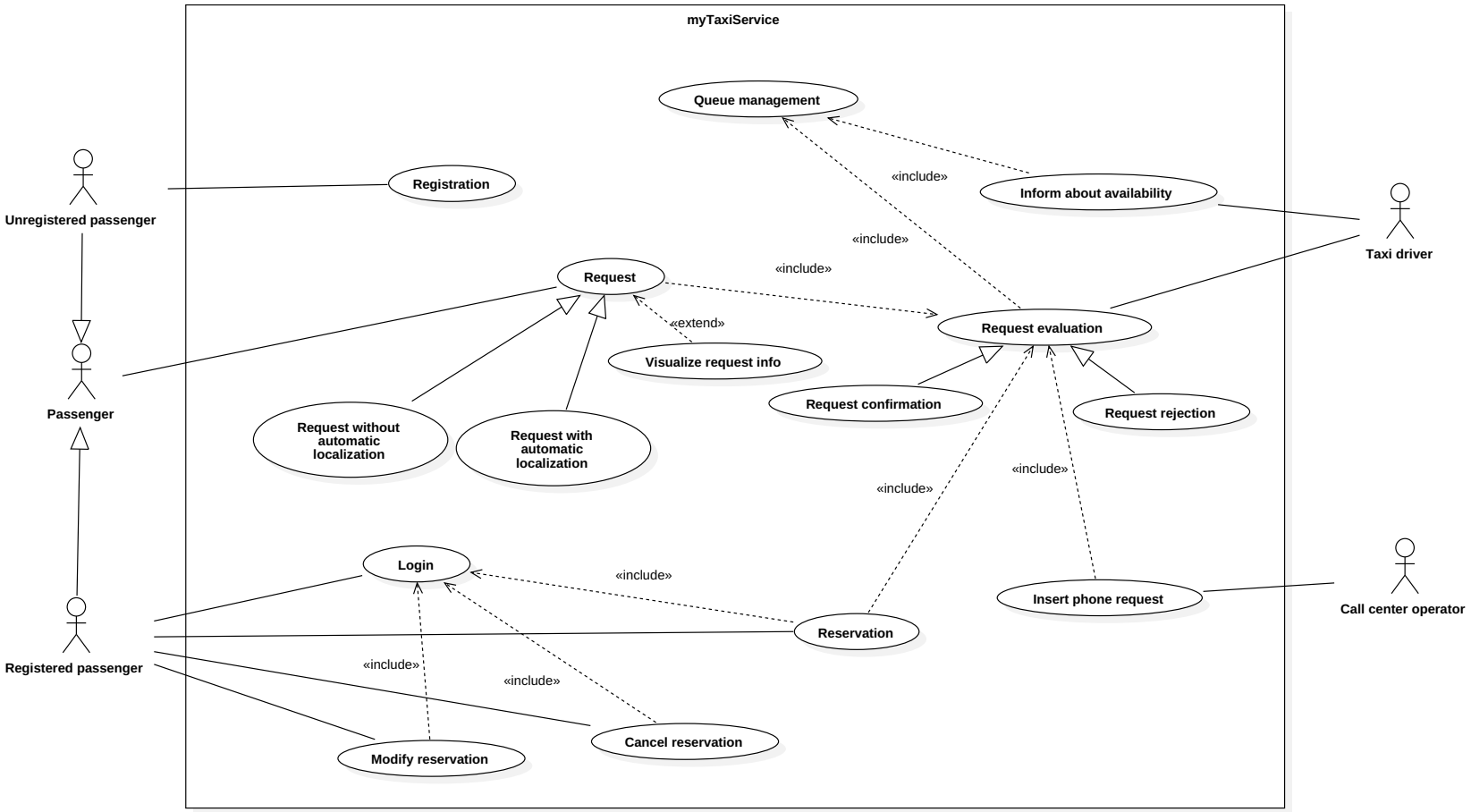
- **[G4] Allow a registered passenger to reserve a taxi.**
- [R4.1] TS shall provide the registered passenger with a form in which he/she has to insert the total number of passengers, the origin and the destination of the ride, the date and time of the meeting.
- [R4.2] TS shall accept only reservations made at least two hours in advance.
- [R4.3] TS shall store the reservation, allocate a request 10 minutes before the meeting time.

Functional requirements
Request evaluation

- **[G6] Allow a taxi driver to either accept or reject a request coming from the system.**
- [R6.1] TS shall show to the chosen taxi driver the request indicating coordinates of the passenger and total number of passengers.
- [R6.2] TS shall provide the taxi driver with a form allowing him to choose if accept or reject the request.
- [R6.3] TS prevents taxi driver to reject twice the same request.
- [R6.4] In case of acceptance, TS shall put the taxi driver into state *busy*, otherwise put taxi driver at the end of the queue and repeat [R1.3]. If no answer from the taxi driver in one minute it is interpreted as a rejection.

Outline

Use cases
UML Use Case diagram



Reservation

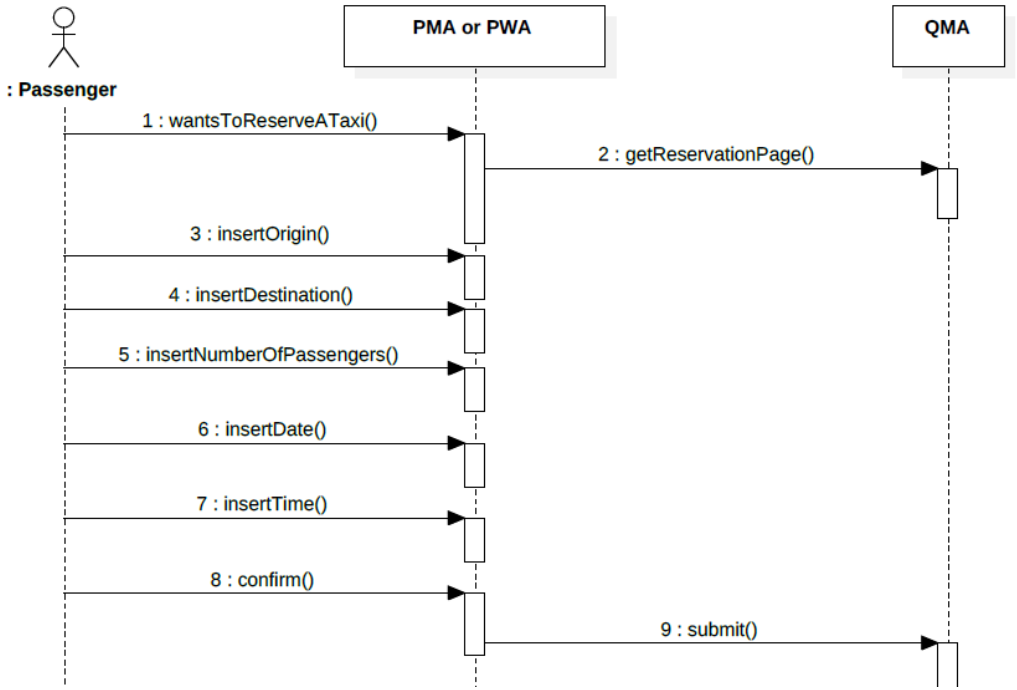
Use case description - 1

Name	Reservation
Related goals	[G4]
Actors	Registered passenger
Entry condition	Passenger is logged in.
Flow of events	1. Passenger accesses to the reservation area. 2. Passenger inserts the required data (origin, destination, date, time, number of passengers). 3. Passenger confirms the reservation. 4. TS system whether data are valid. 5. QMA creates a new reservation and the related request is allocated.

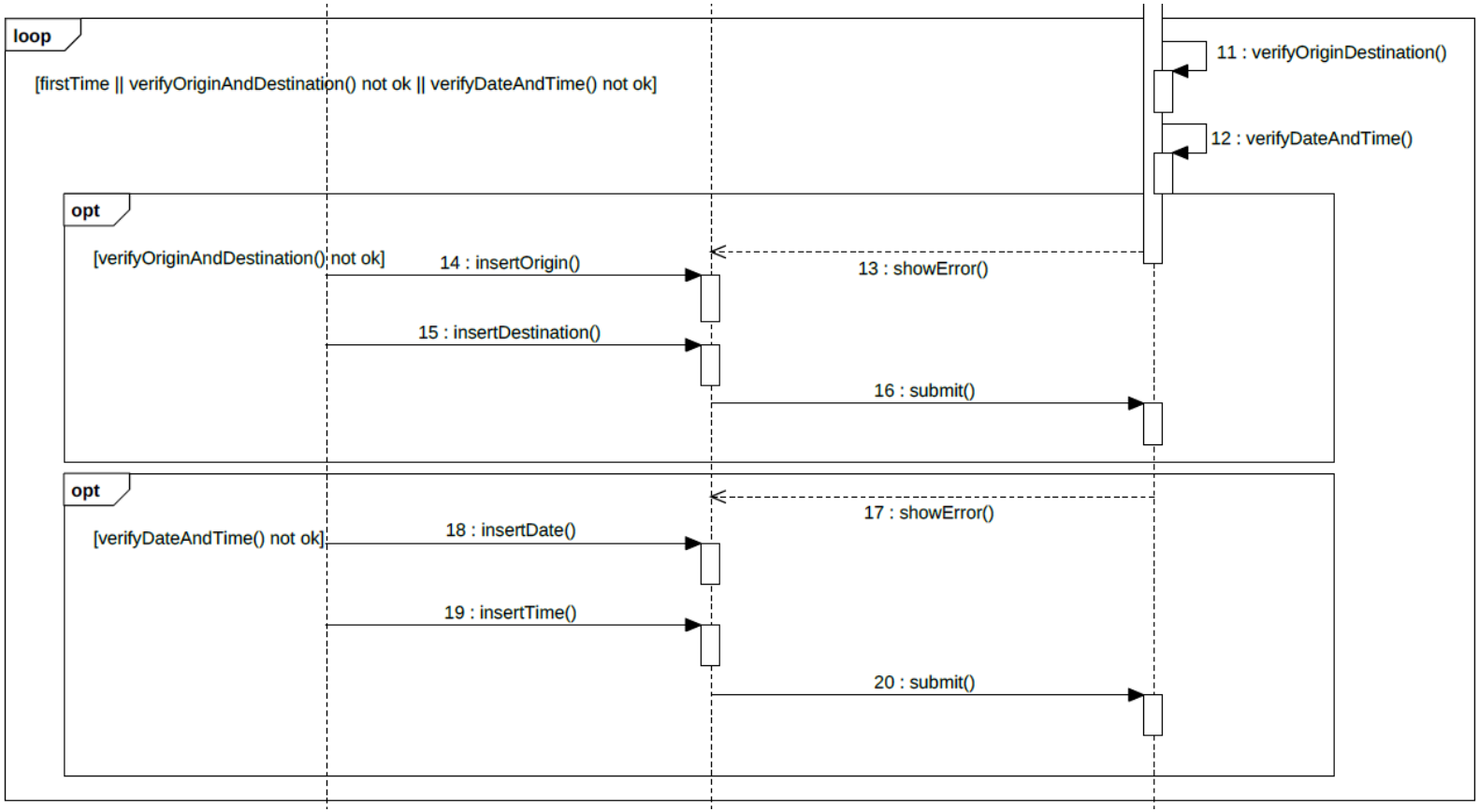
Reservation
Use case description - 2

Exit condition	The reservation is added to the TS system.
Exceptions	• If passenger does not confirm the operation is not performed. • If the data are not valid (origin, destination, number of passengers) an error message is shown to passenger and the operation is not performed. Passenger can repeat the process. • If the date and time are such that the reservation is not made at least two hour in advance an error message is shown to user and the operation is not performed. Passenger can repeat the process.

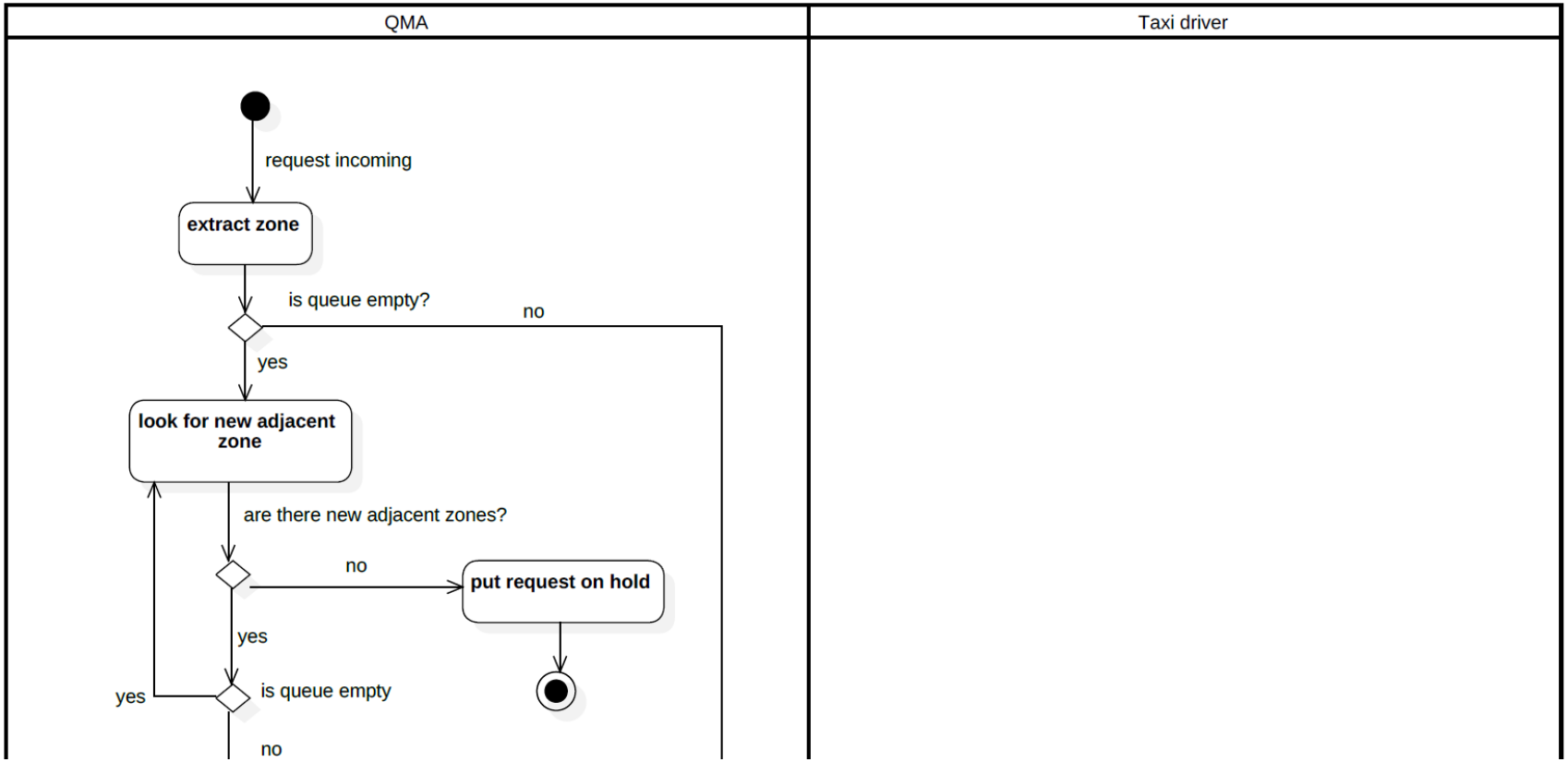
Reservation
Sequence diagram - 1



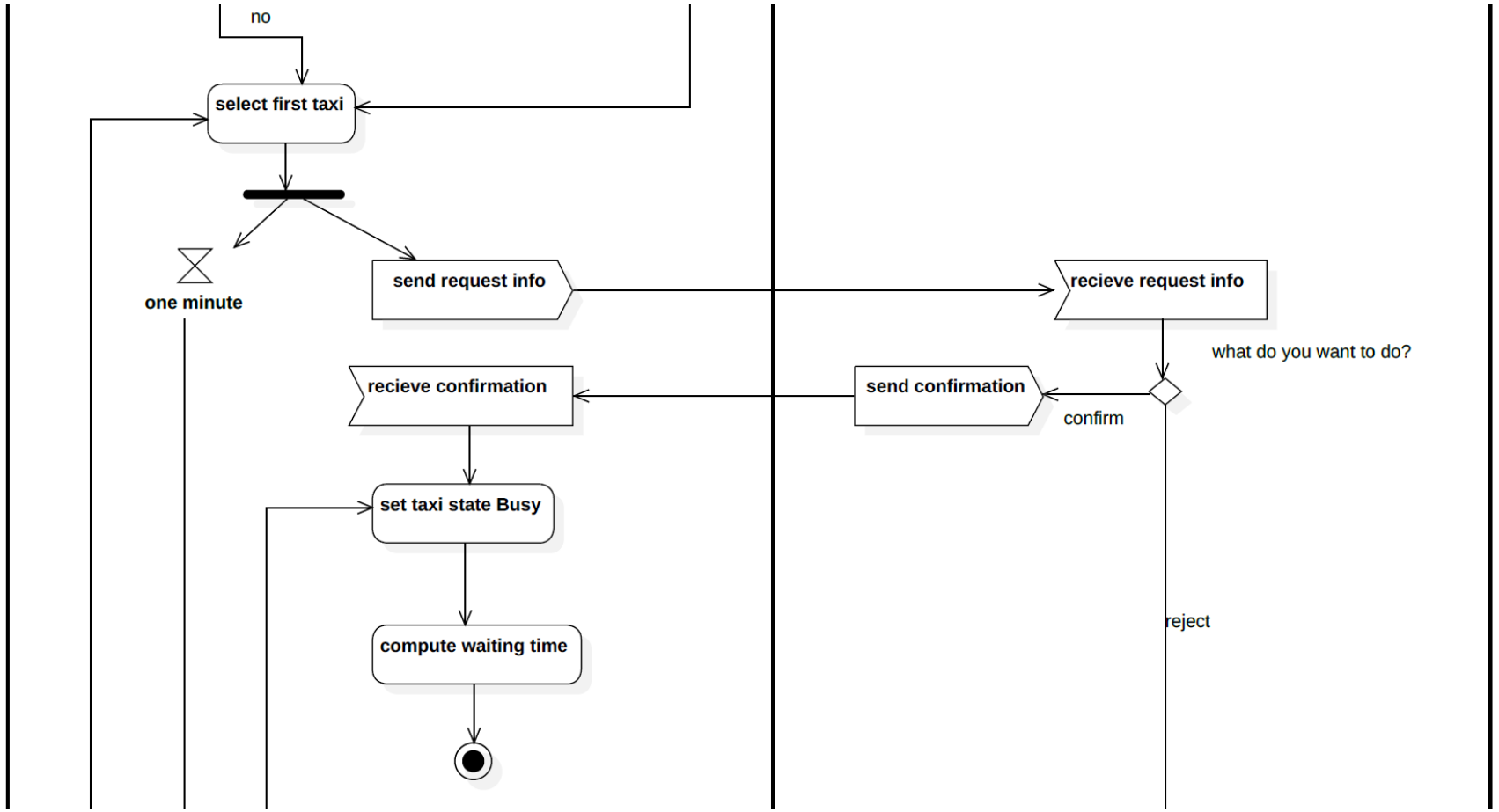
Reservation
Sequence diagram - 2



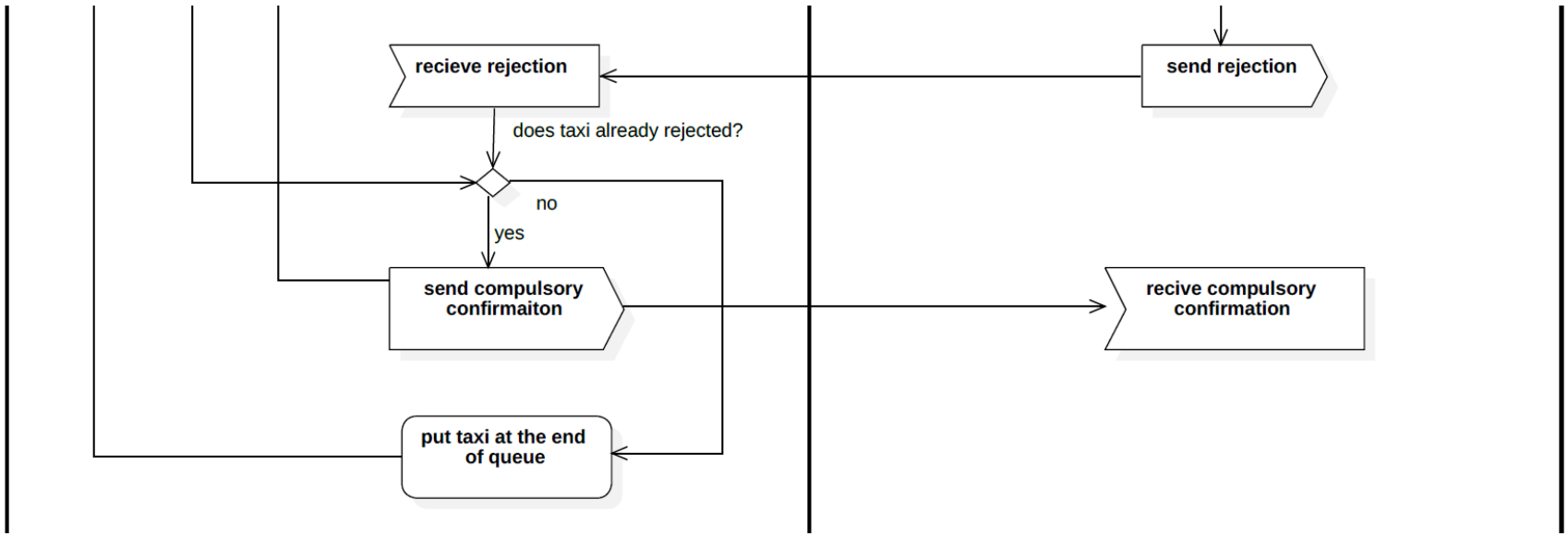
Request evaluation
Activity diagram - 1



Request evaluation
Activity diagram - 2

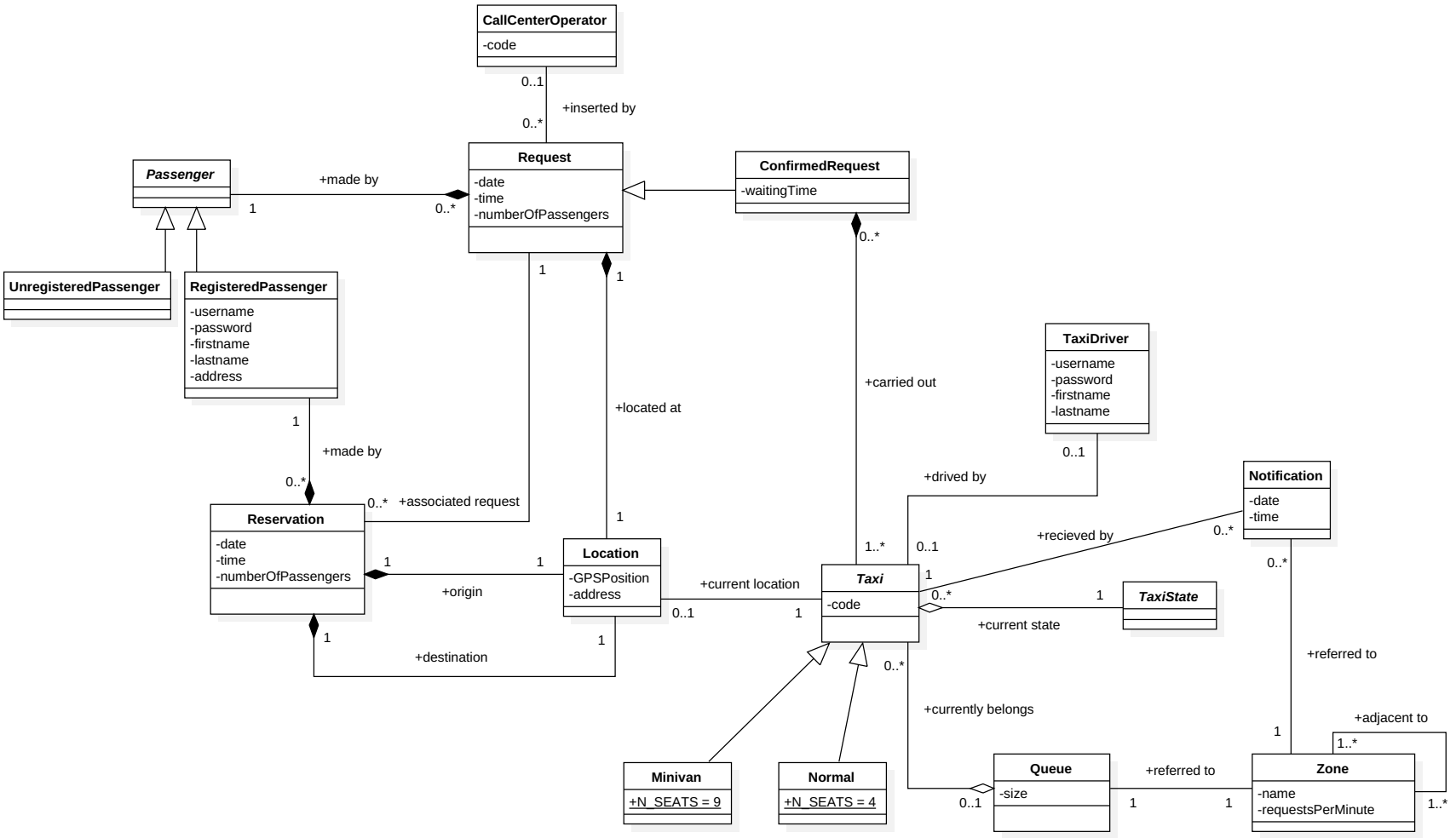


Request evaluation
Activity diagram - 3

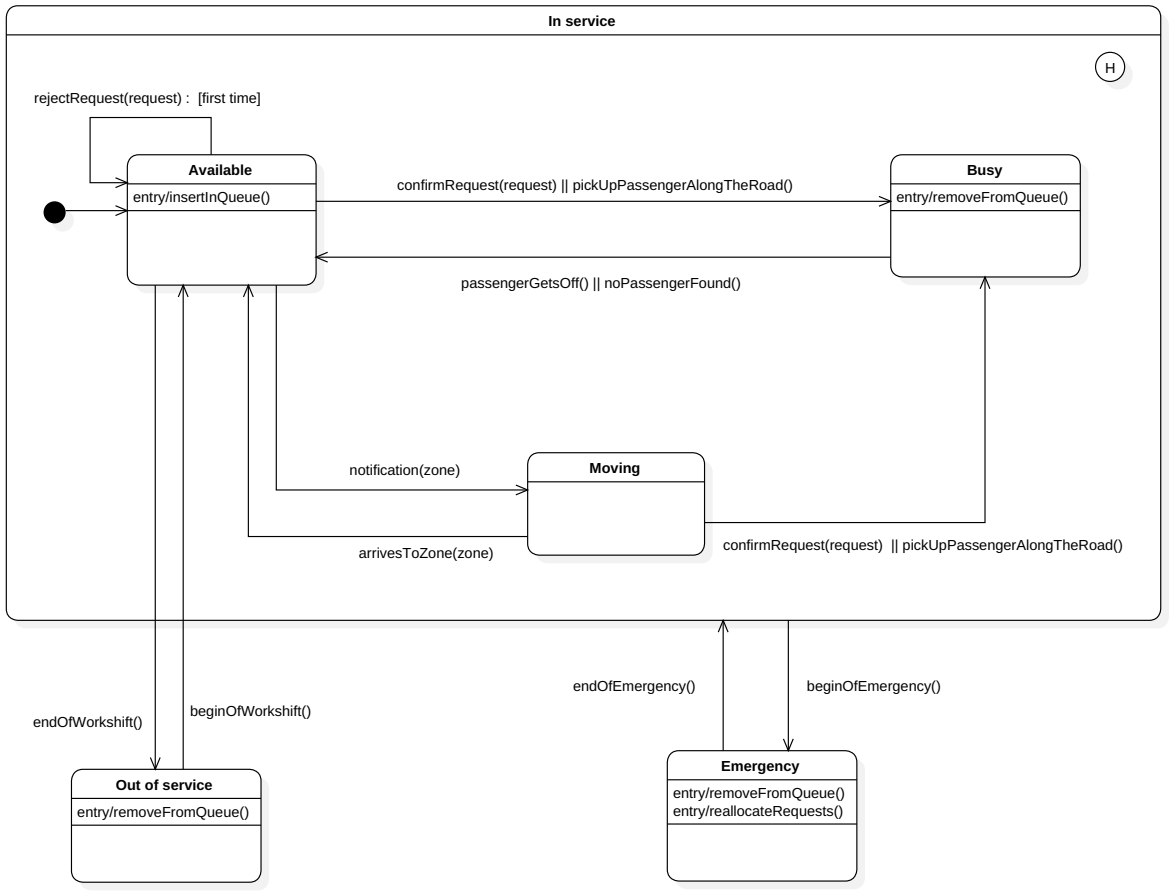


Outline

Class diagram



State Chart


In service
H
rejectRequest(request) : [first time]
Available
entry/insertInQueue()
confirmRequest(request) || pickUpPassengerAlongTheRoad()
Busy
entry/removeFromQueue()
passengerGetsOff() || noPassengerFound()
notification(zone)
Moving
arrivesToZone(zone)
confirmRequest(request) || pickUpPassengerAlongTheRoad()
endOfWorkshift()
beginOfWorkshift()
endOfEmergency()
beginOfEmergency()
Out of service
entry/removeFromQueue()
Emergency
entry/removeFromQueue()
entry/reallocateRequests()

Outline

Non functional requirements

- Performance
- Reliability
- Availability
- Security
- Maintainability
- Portability
- Documentation
- User interface and human factors

Outline

Alloy model

Some signatures - 1

```
abstract sig Passenger{}
sig UnregisteredPassenger extends Passenger{}
sig RegisteredPassenger extends Passenger{}

abstract sig TaxiState{}
one sig OutOfService,Emergency extends TaxiState{}
one sig Available, Busy, Moving extends TaxiState{}

abstract sig Taxi {
        driver: lone TaxiDriver,
        state: one TaxiState,
        numberOfSeats: one Int,
}

sig MinivanTaxi extends Taxi {} {numberOfSeats = 9}
sig NormalTaxi extends Taxi {} {numberOfSeats = 4}
```

Alloy model
Some signatures - 2

```
sig Request{
        passenger: one Passenger,
        date: one Date,
        time: one Time,
        numberOfPassengers: one Int,
        location: one Location,
} {numberOfPassengers>=1}

sig ConfirmedRequest extends Request{
        waitingTime: one Time,
        taxis: some Taxi,
}
```

Alloy model
Some facts - 1

```
//Origin and destination for each request must be
    different
fact originAndDestinationDifferent {
        all r: Reservation | r.origin != r.destination
}

//In each request the number of seats must be
    sufficient wrt number of passengers
fact numberOfSeatsSufficient {
        all r: ConfirmedRequest | sum r.taxis.
            numberOfSeats
                >= r.numberOfPassengers
}
```

Alloy model
Some facts - 1

```
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//In each request the number of seats must be
    sufficient wrt number of passengers
fact numberOfSeatsSufficient {
        all r: ConfirmedRequest | sum r.taxis.
            numberOfSeats
                >= r.numberOfPassengers
}
```

Alloy model
Some facts - 2

```
//The number of taxis sent are the minimun requested
    to pick up all passengers
fact numberOfSeatsAreTheMinimumRequired {
        all r: ConfirmedRequest | no taxiSubset: set
            Taxi | taxiSubset in r.taxis and
            taxiSubset != r.taxis and sum taxiSubset.
            numberOfSeats >= r.numberOfPassengers
}
```

```
fact numberOfSeatsAreTheMinimumRequired {
        all r: ConfirmedRequest | no t: Taxi | t in r.
            taxis and sum r.taxis.numberOfSeats - t.
            numberOfSeats >= r.numberOfPassengers
}
```

Alloy model
Some facts - 2

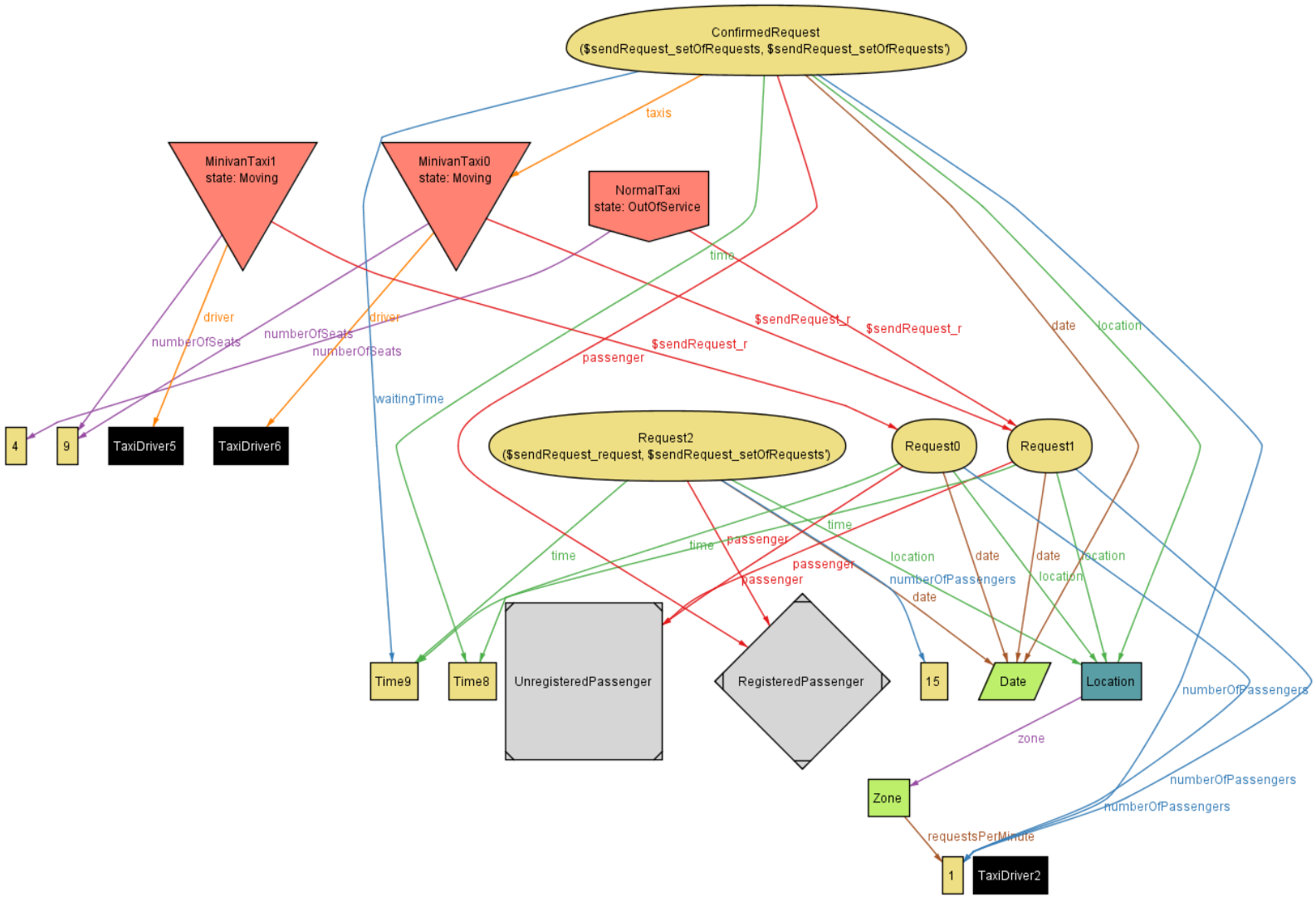
```
//The number of taxis sent are the minimun requested
    to pick up all passengers
fact numberOfSeatsAreTheMinimumRequired {
        all r: ConfirmedRequest | no taxiSubset: set
            Taxi | taxiSubset in r.taxis and
            taxiSubset != r.taxis and sum taxiSubset.
            numberOfSeats >= r.numberOfPassengers
}

fact numberOfSeatsAreTheMinimumRequired {
        all r: ConfirmedRequest | no t: Taxi | t in r.
            taxis and sum r.taxis.numberOfSeats - t.
            numberOfSeats >= r.numberOfPassengers
}
```

Alloy model
Predicates

```
//Predicate for sending a request: if the request is not already confirmed and it is not already in the set it is added to the set
pred sendRequest[setOfRequests,setOfRequests': set Request, request: Request] {
    no ((ConfirmedRequest + setOfRequests) & request) implies
        setOfRequests' = setOfRequests + request
    else
        setOfRequests' = setOfRequests
}
```

Alloy model

World generated by pred sendRequest



Alloy model
Assertions

```
//Request carried out by the same taxi driver must be
    different in date or time
assert allRequestOfTheSameTaxiDriverDifferentInTime {
        all td: TaxiDriver | all disj r1,r2:
            ConfirmedRequest | td in (r1.taxis.driver
            & r2.taxis.driver) implies not
            atTheSameTime[r1,r2]
}
```

Executing "Check allRequestOfTheSameTaxiDriverDifferentInTime for 10"
Solver=sat4j Bitwidth=4 MaxSeq=7 SkolemDepth=1 Symmetry=20
50129 vars. 2338 primary vars. 125356 clauses. 109ms. No
counterexample found. Assertion may be valid. 219ms.

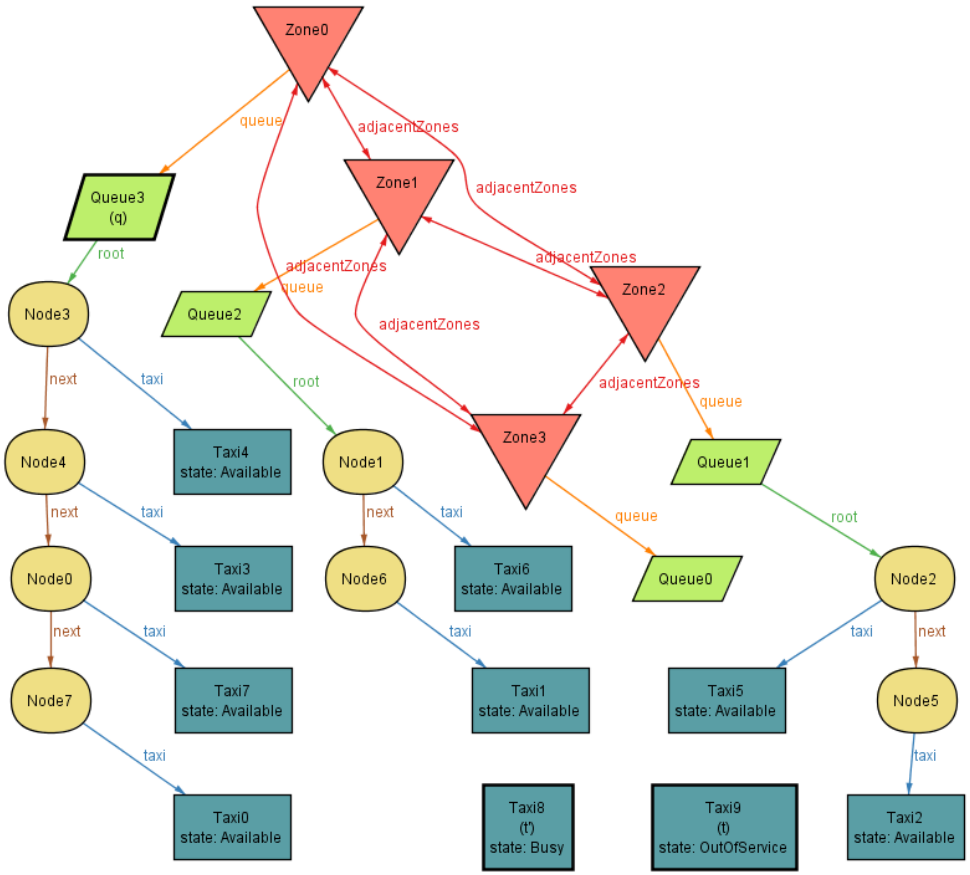
Alloy model
Queue modeling - 1

```
sig Zone{
        queue: one Queue,
        adjacentZones: some Zone,
}

//Queue definition
sig Queue {
        root: lone Node
}

sig Node {
        taxi: one Taxi,
        next: lone Node
}
```

Alloy model
Queue modeling - 2

```
//Structural properties
fact queueStructuralProperties {

        //Each node belongs to exactly one queue
        all n: Node | one q: Queue | n in q.root.*next
        //No cycles
        no n: Node | n in n.^next
}

//Adjacency relation between zones is simmetric but
    not reflexive
fact adjacencySimmetricButNotReflexive {
        adjacentZones in ~adjacentZones
        no adjacentZones & iden
}
```

Alloy model
World generated



References

- IEEE Software Engineering Standards Committee, "IEEE Std 830-1998, IEEE Recommended Practice for Software Requirements Specifications", October 20, 1998.
- P, Zave, M. Jackson, Four dark corners of requirements engineering, TOSEM 1997.
- Software Abstractions: Logic, Language, and Analysis, revised edition Edition by Daniel Jackson, MIT Press.
- Software Engineering 2 course slides.

Questions