myTaxiService

Software Engineering 2 - Project

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Outline

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Pattern + Style = Architecture

PROBLEM

CONTEXT

Pattern + Style = Architecture

PROBLEM

PATTERN

STYLE

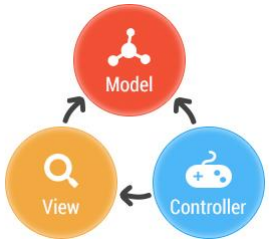
CONTEXT

Pattern + Style = Architecture

PROBLEM

PATTERN

MVC



STYLE

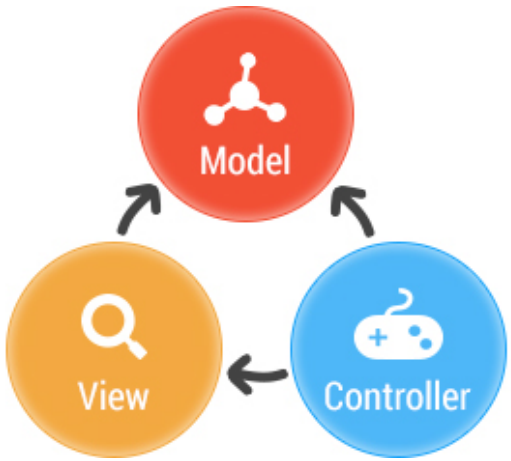
CONTEXT

CLIENT/SERVER

MVC
Architectural pattern

Problem: applications with user interface

- Separation of concerns
- Design and conquer development
- Maintainability



Client/Server

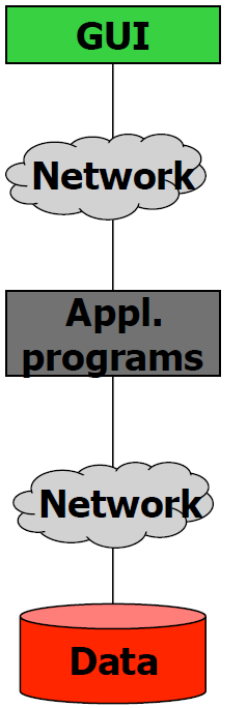
Architectural style

Context: distributed application

- Separation of roles
- Lot of source of information
- Just one elaboration point
- Maintainability

Three tier
Architectural style flavour

- Different computational and storage resource
- Presentation on clients (Tier 1)
- Separation between
  - data (Tier 3) and
  - business logic (Tier 2)
- Further separation within Tier 2:
  - visualization (web server)
  - processing (application server)



Overall architecture

Presentation tier

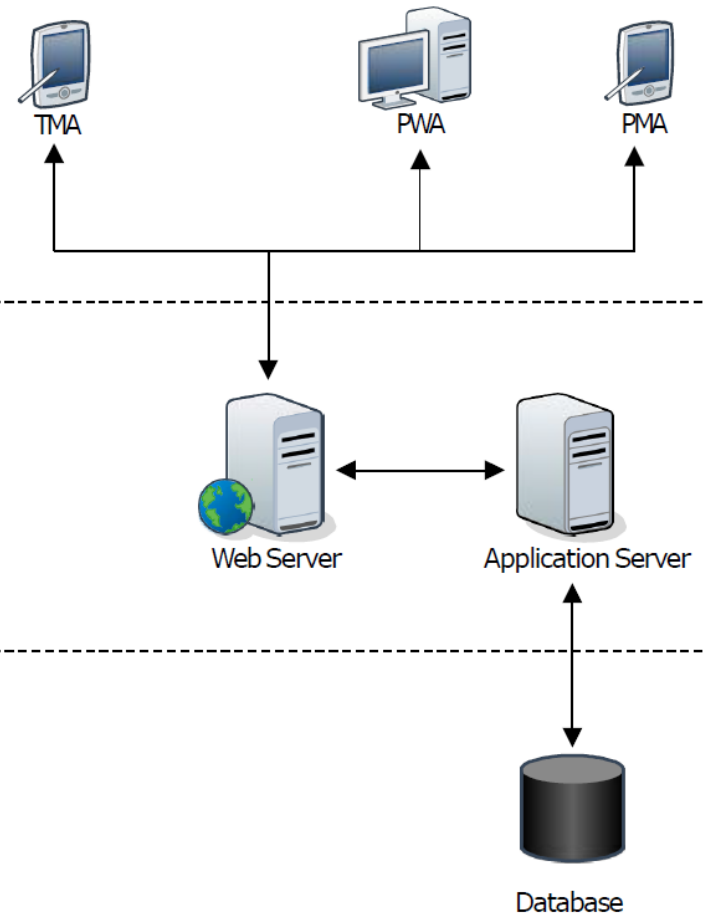
Passengers and taxi drivers use the client applications to send request through the web. Clients perform input validation, send request to the server and show the response received from the server to the users.

Application tier

A server web recives the clients' requests and an application server performs the requested actions. If needed, the application server composes a query to ask the database and sends uses the result to complete the action.

Data tier

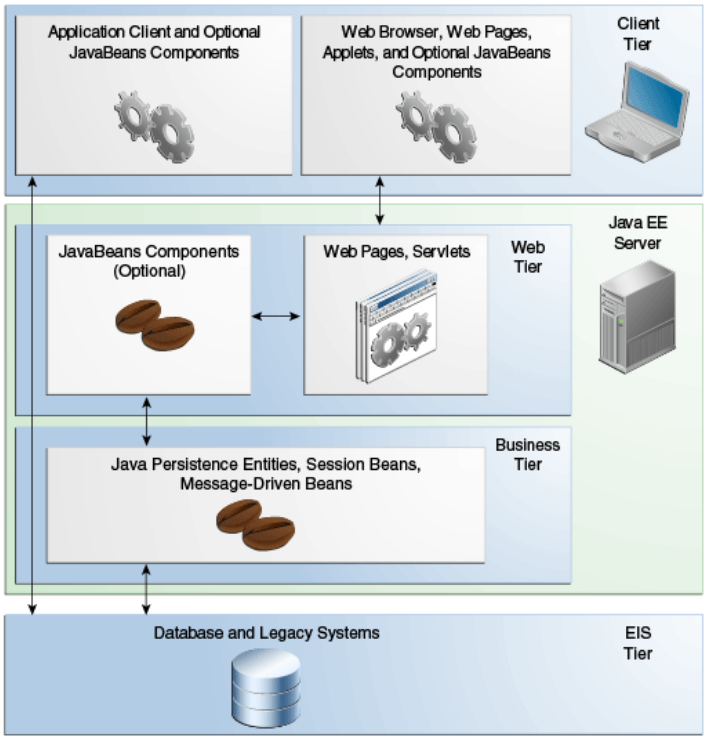
The database stores and menages all the data required to perform the service. It receives query from the logic layer, computes the answer and sends back the result.



Outline

JEE Architecture
Motivations

- Modularity
- Reliability
- Security
- Portability
- Scalability



Outline

Subsystems

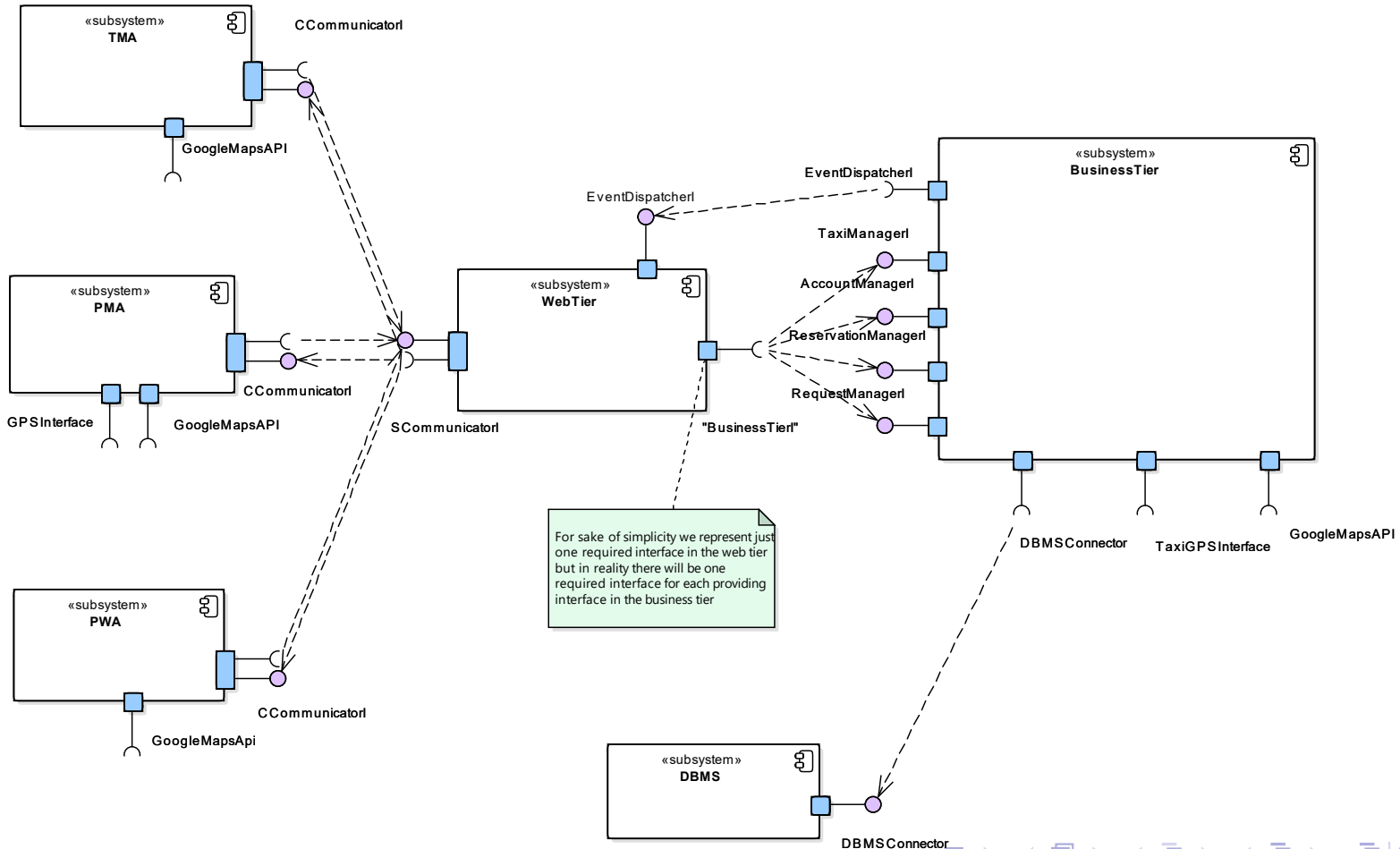
Definition

A *subsystem* is a group of components that belong to the same "role"

- TMA (Taxi Mobile Application)
- PMA (Passenger Mobile Application)
- PWA (Passenger Web Application)
- Web tier
- Business tier
- DBMS

Subsystems
High level component diagram

Link



Components
Business Tier

Definition

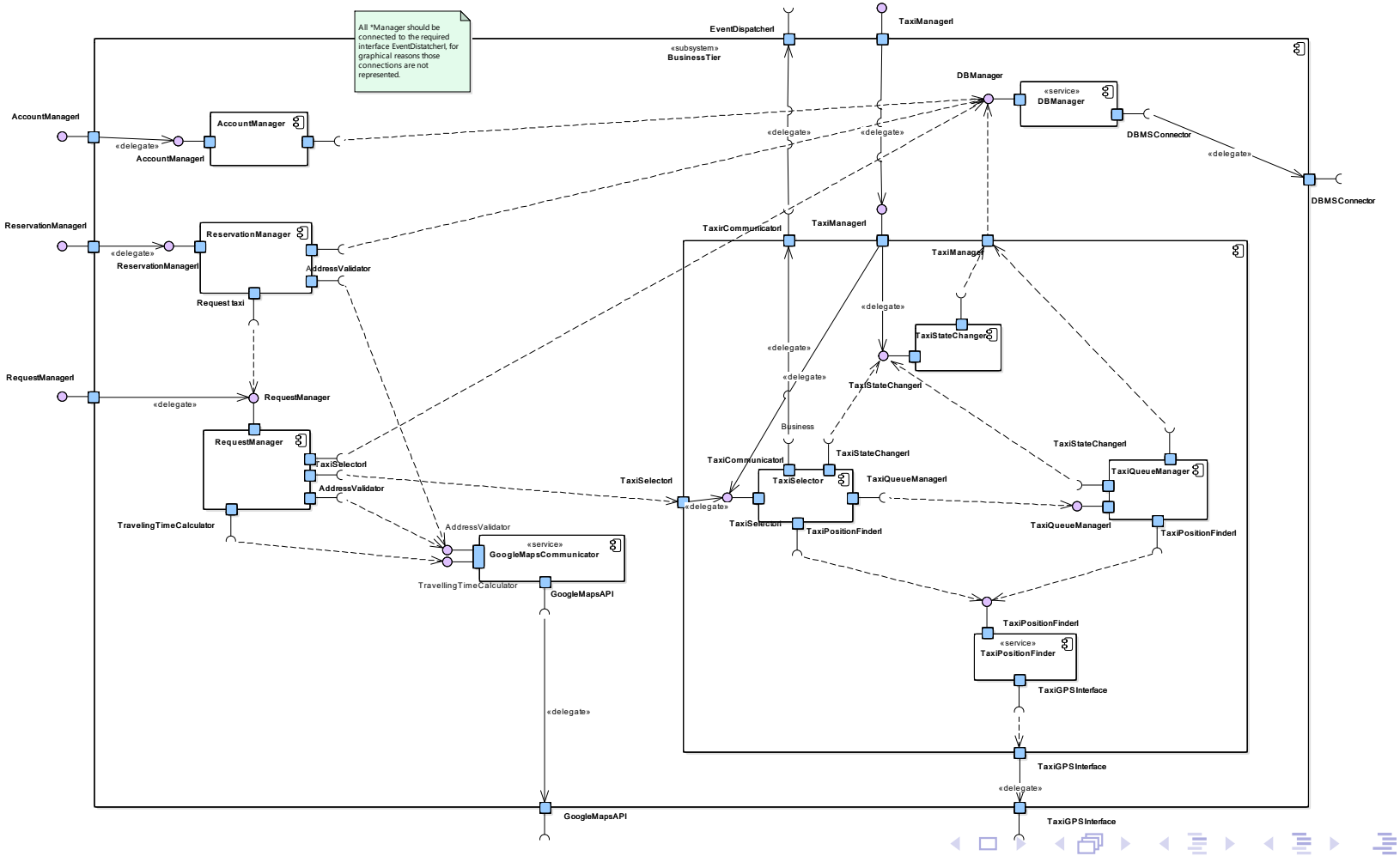
A *component* is a cohesive and little coupled group of functionalists that can be almost mapped to a programmatic class.

- AccountManager
- RequestManager
- ReservationManager
- GoogleMapsCommunica-tior
- DBManager
- TaxiManager (*macro-component*)
  - TaxiSelector
  - TaxiPositionFineder
  - TaxiQueueManager
  - TaxiStateChanger

Components

Business Tier - Component diagram

Link



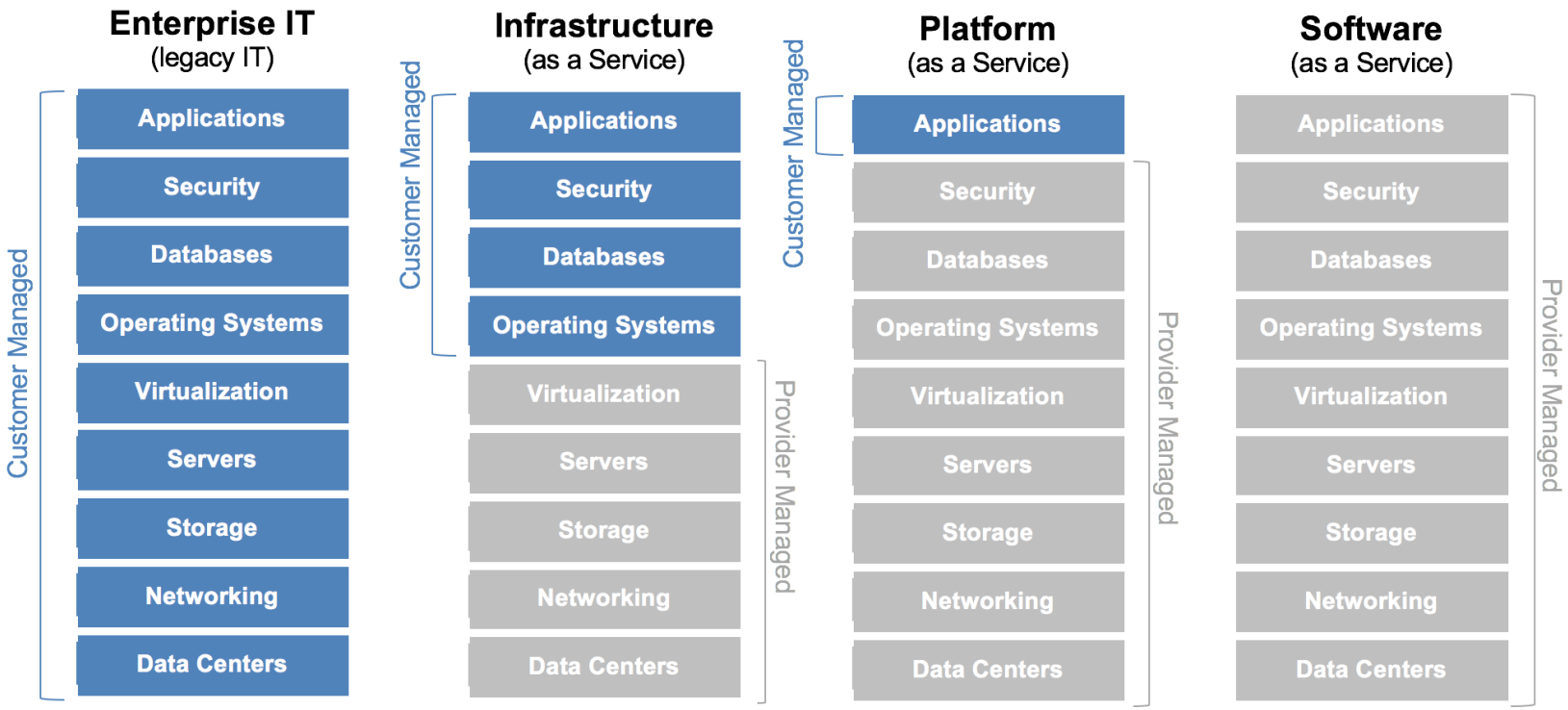
Outline

Cloud deployment
Motivations

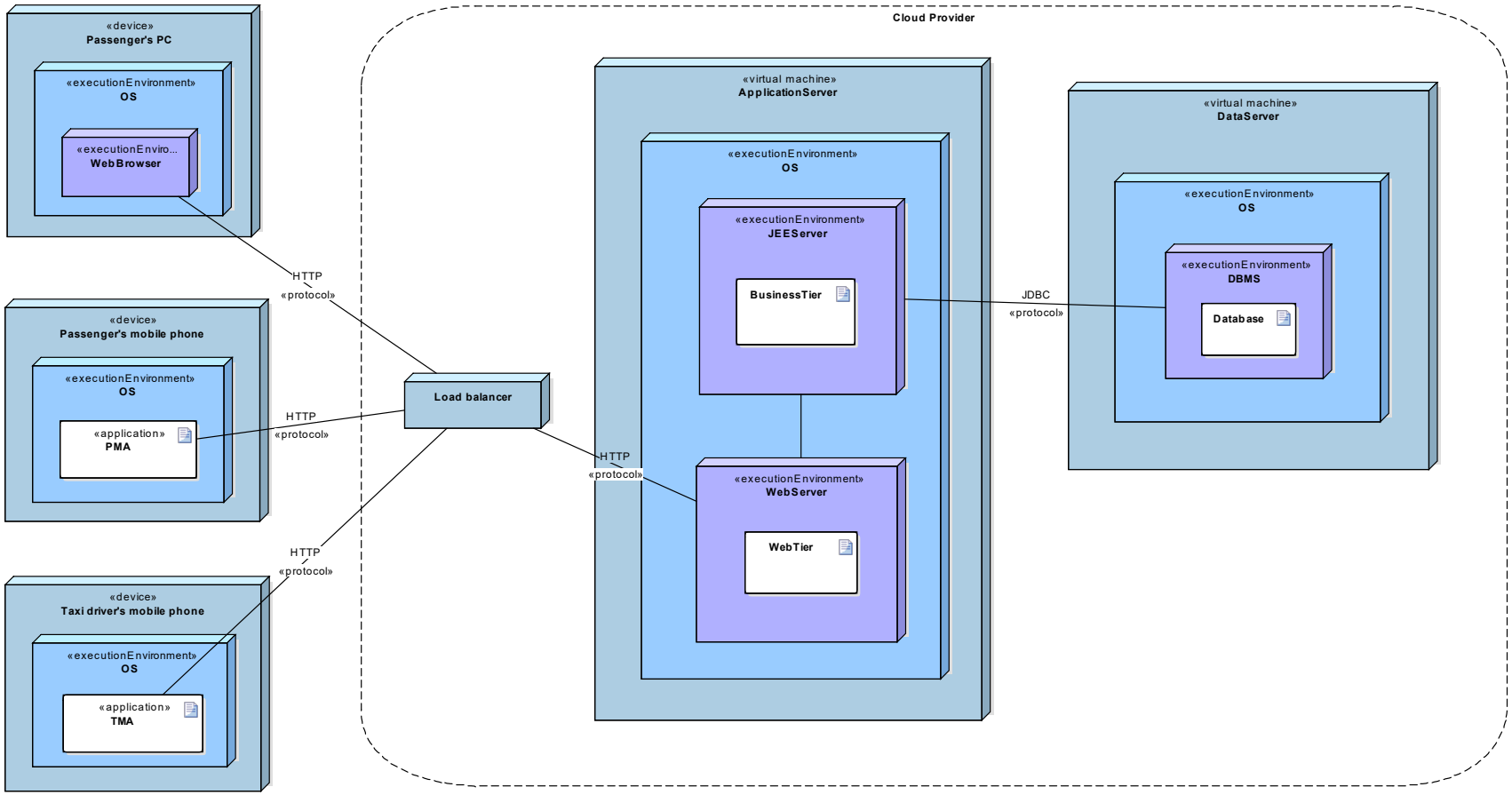
IaaS deployment

- Different traffic loads: upward and downward *scalability*
- Costs: no acquisition costs, *pay-as-you-go*
- Security: physical security
- Availability: redundancy in hw and configurations, automatic backup

Cloud deployment
Comparison



Cloud deployment
Deployment diagram



Outline

Request
Sequence diagram

Link

Reservation
Sequence diagram

Link

Outline

Taxi queue management

The problem - 1

- Z set of zones
- N number of available taxis at the moment
- n_i number of requests per minute in zone $i \in Z$
- q_i actual number of available taxis in zone $i \in Z$
- t_i suitable number of available taxis in zone $i \in Z$

$$t_i = \frac{n_i}{\sum_i n_i} N$$

- $t_{i,min}$ minimum acceptable number of available taxis in zone $i \in Z$

$$t_{i,min} = 0.7\, t_i$$

Taxi queue management
The problem - 2

Given the current distribution of taxis among the zones $Q = \{q_i | i \in Z\}$ how can we move a set of taxis in order to satisfy the *demand constraint* $q_i \geq t_{i,min} \forall i \in Z$ **minimizing** the total number of zones traveled?

Taxi queue management
Analysis - 1

Let's partition Z in $\{Z_+, Z_-\}$

- $Z_+ = \{i \in Z | q_i \geq t_{i,min}\}$ zones with more taxis than needed.
- $Z_- = \{i \in Z | q_i < t_{i,min}\}$ zones with less taxis than needed.
- d_{ij} distance between (number of zones in between) zone $i \in Z_+$ and zone $j \in Z_-$.

Taxi queue management
Analysis - 2

x_{ij} number of taxis to be moved from zone $i \in Z_+$ and zone $j \in Z_-$(decision variables).

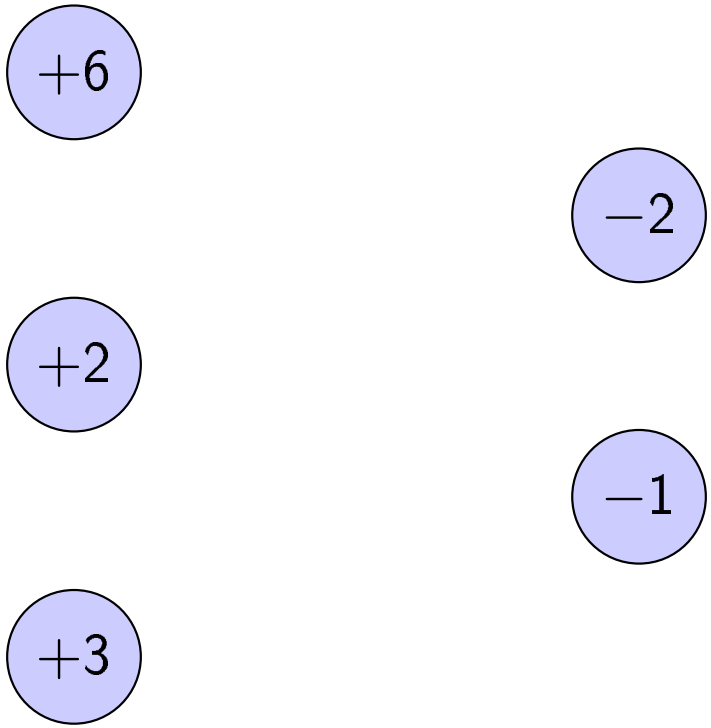
$$\min \sum_{i \in Z_+} \sum_{j \in Z_-} x_{ij} d_{ij}$$

s.t.

- $x_{ij} \geq 0 \, \forall i \in Z_+, j \in Z_-$ (non negativity constraint);
- $q_i - \sum_{j \in Z_-} x_{ij} \geq t_{i,min} \, \forall i \in Z_+$ (availability constraint);
- $q_j + \sum_{i \in Z_+} x_{ij} \geq t_{j,min} \, \forall j \in Z_-$ (demand constraint);
- x_{ij} integer $\forall i \in Z_+$, $\forall j \in Z_-$.

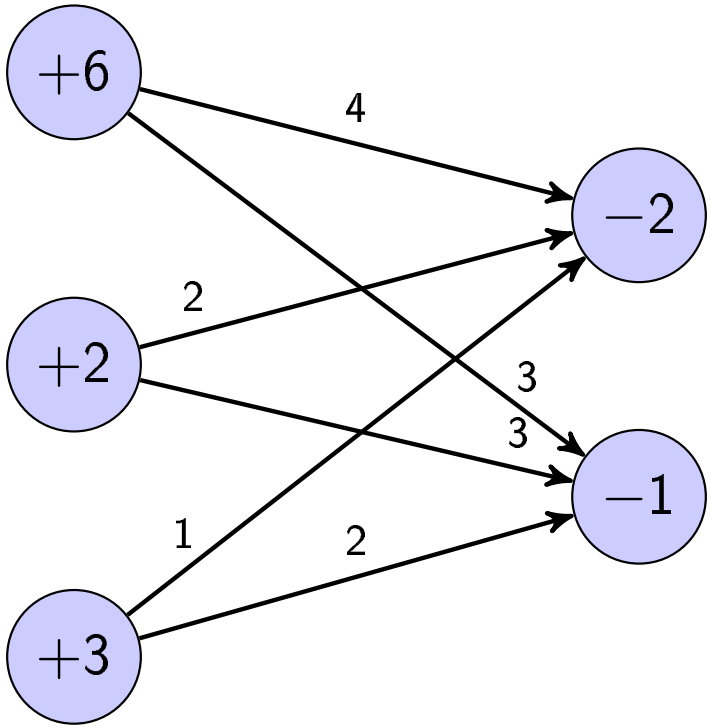
Taxi queue management

Example - 1



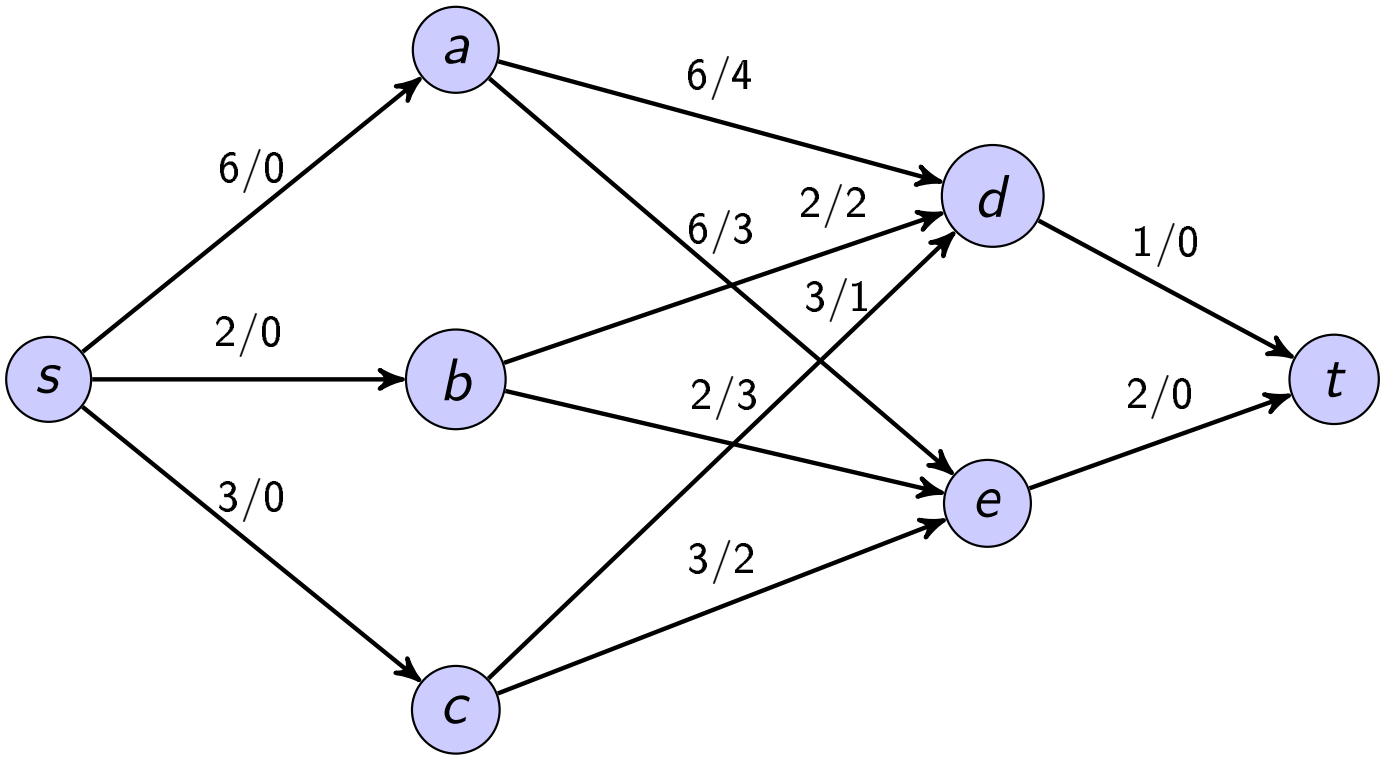
Taxi queue management

Example - 2



Taxi queue management

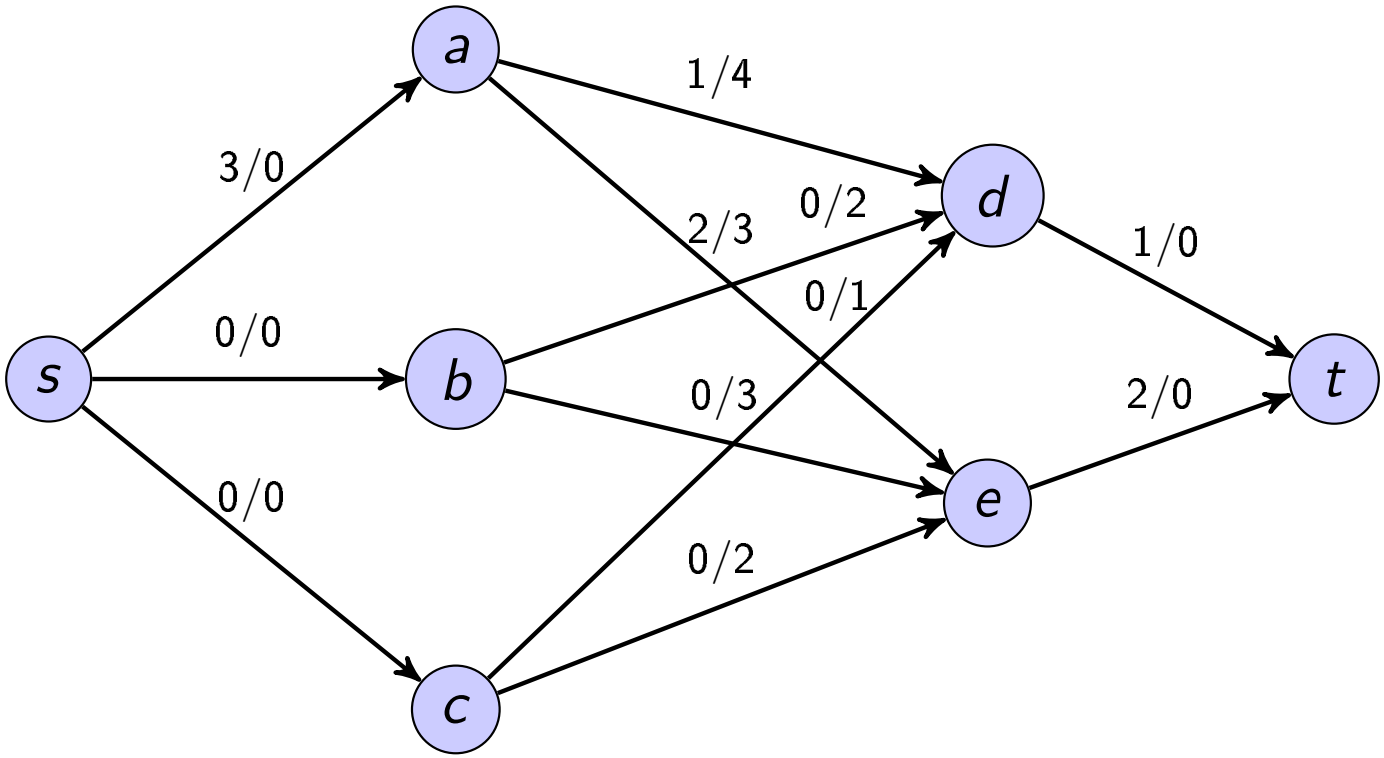
Example - Network



k_{ij}/d_{ij}

Taxi queue management

Example - a maximum flow found with Edmonds-Karp

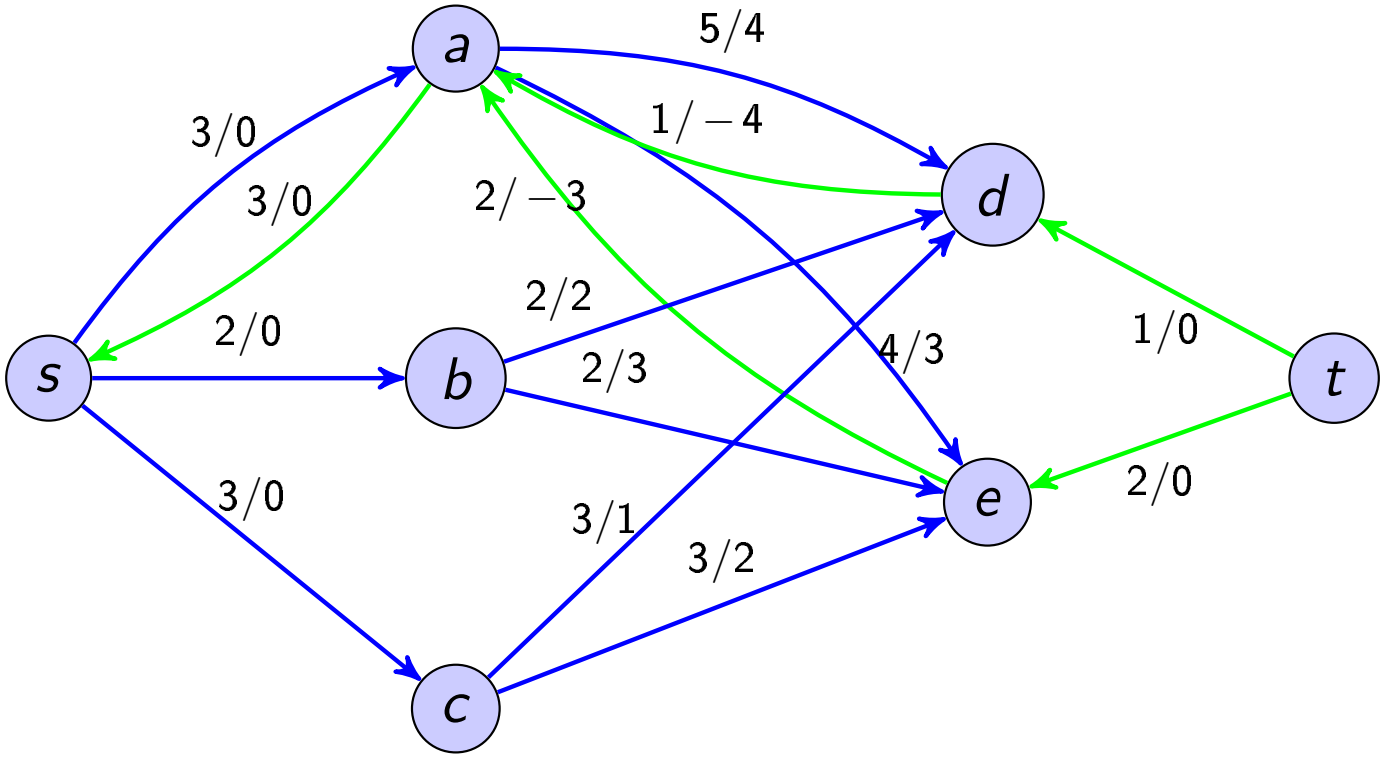


$$x_{ij}/d_{ij} \qquad \sum_{i \in Z_+} \sum_{j \in Z_-} x_{ij} d_{ij} = 10$$

Taxi queue management

Example - Minimum cost flow - Incremental network

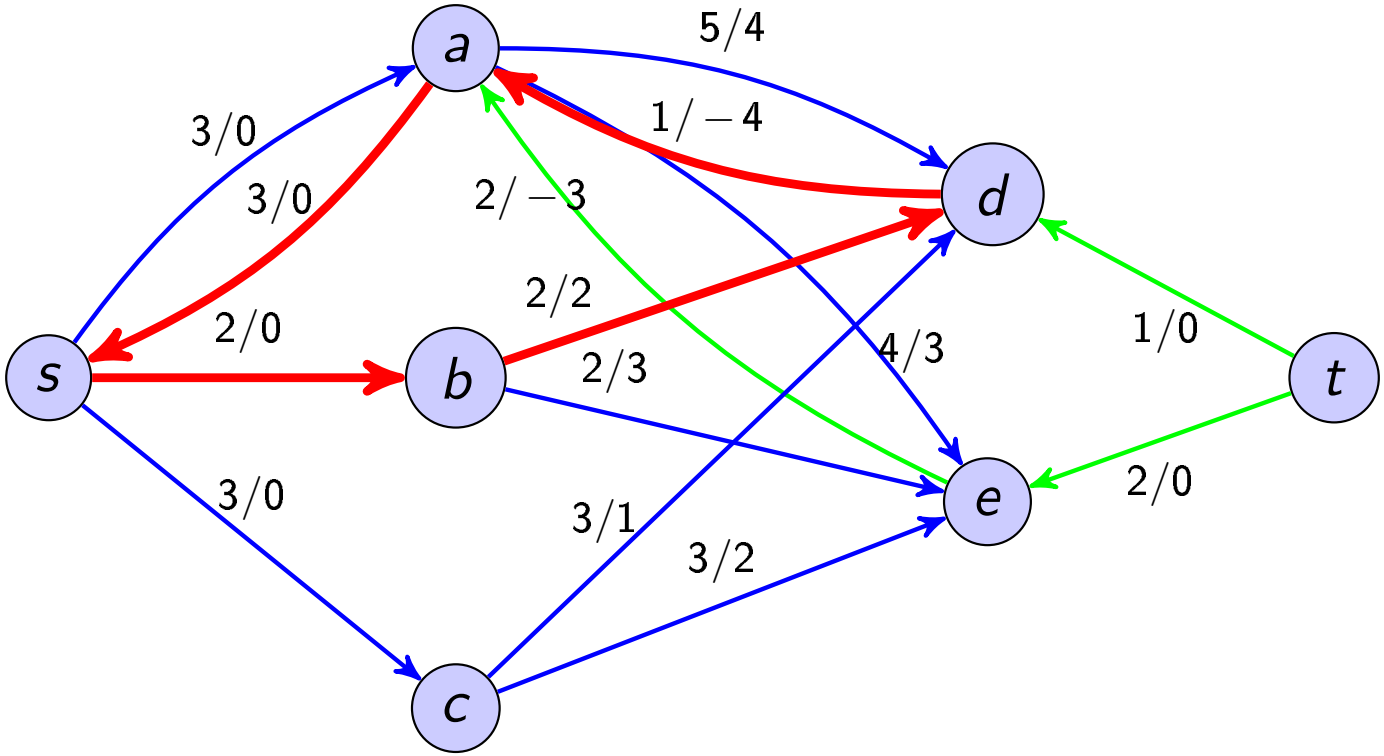
Let's have a look at the residual network. Could we find a negative cost cycle?



Taxi queue management

Example - Minimum cost flow - Negative cost canceling

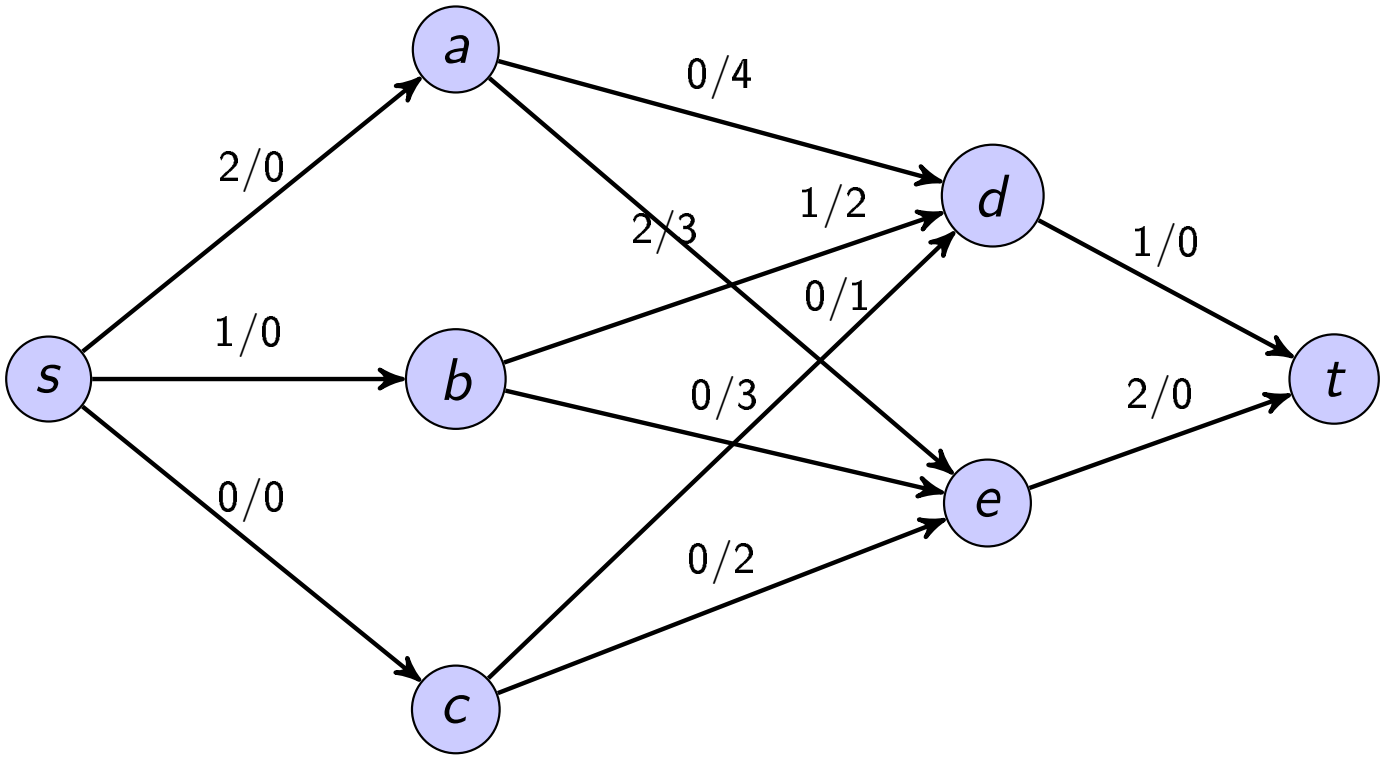
Yes! s - b - d - a - s



$\overline{k_{ij}}/\overline{d_{ij}} \quad \delta = \min\{2,4,1,3\} = 1$

Taxi queue management

Example - New maximum flow with smaller cost



$$x_{ij}/d_{ij} \qquad \sum_{i \in Z_+} \sum_{j \in Z_-} x_{ij} d_{ij} = 8 < 10$$

Taxi queue management
Algorithm

1. Find a maximum flow
2. While there exists a negative cost cycle
    1. Build the incremental network
    2. Find the negative cost cycle
    3. Update the flow

The complexity is $O(|Z||A'|^2 k_{max} d_{max})$

With some refining (minimum mean cycle)
$O(|Z|^2|A'|^2 \log(|Z| d_{max}))$

Taxi queue management
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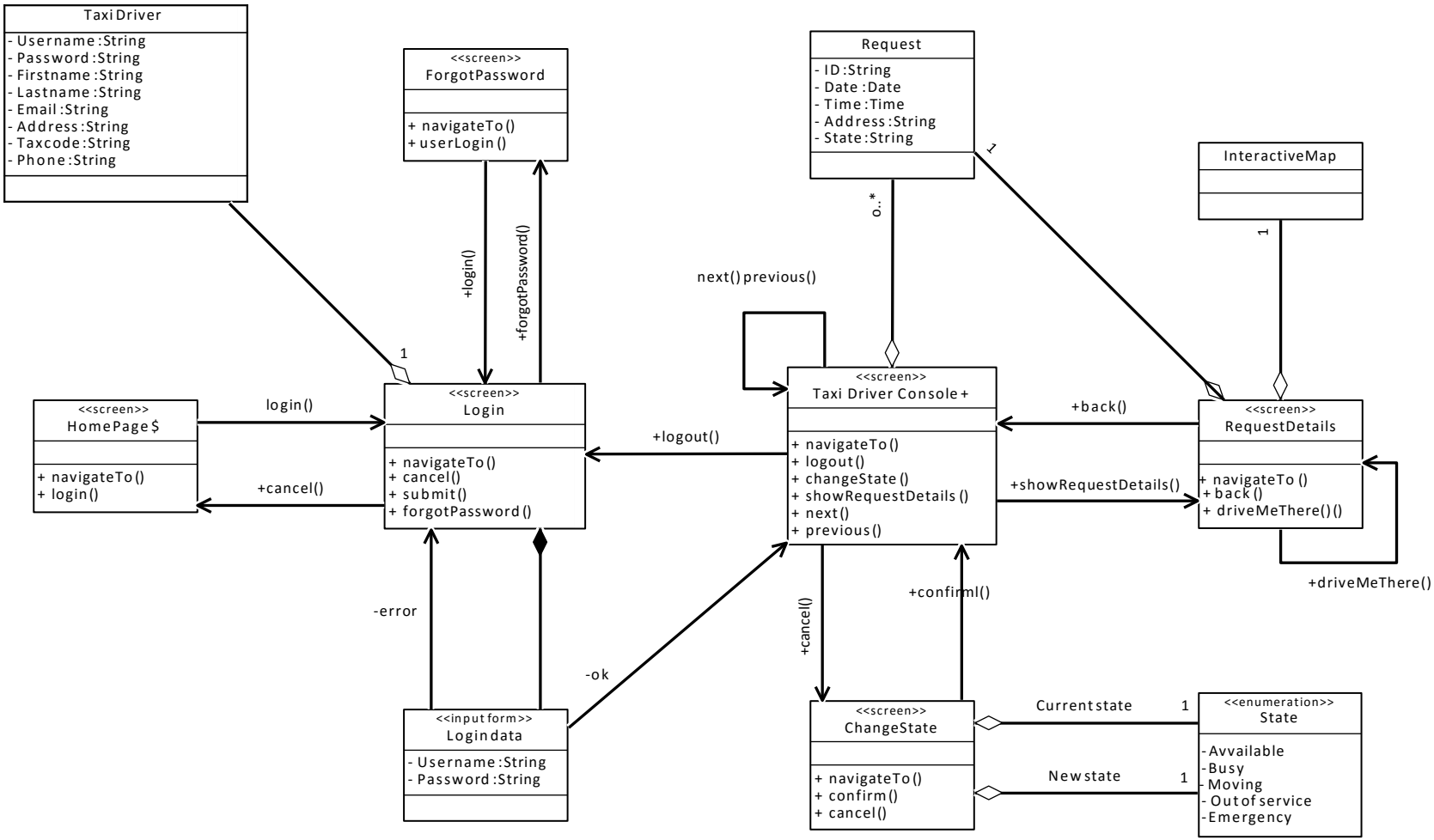
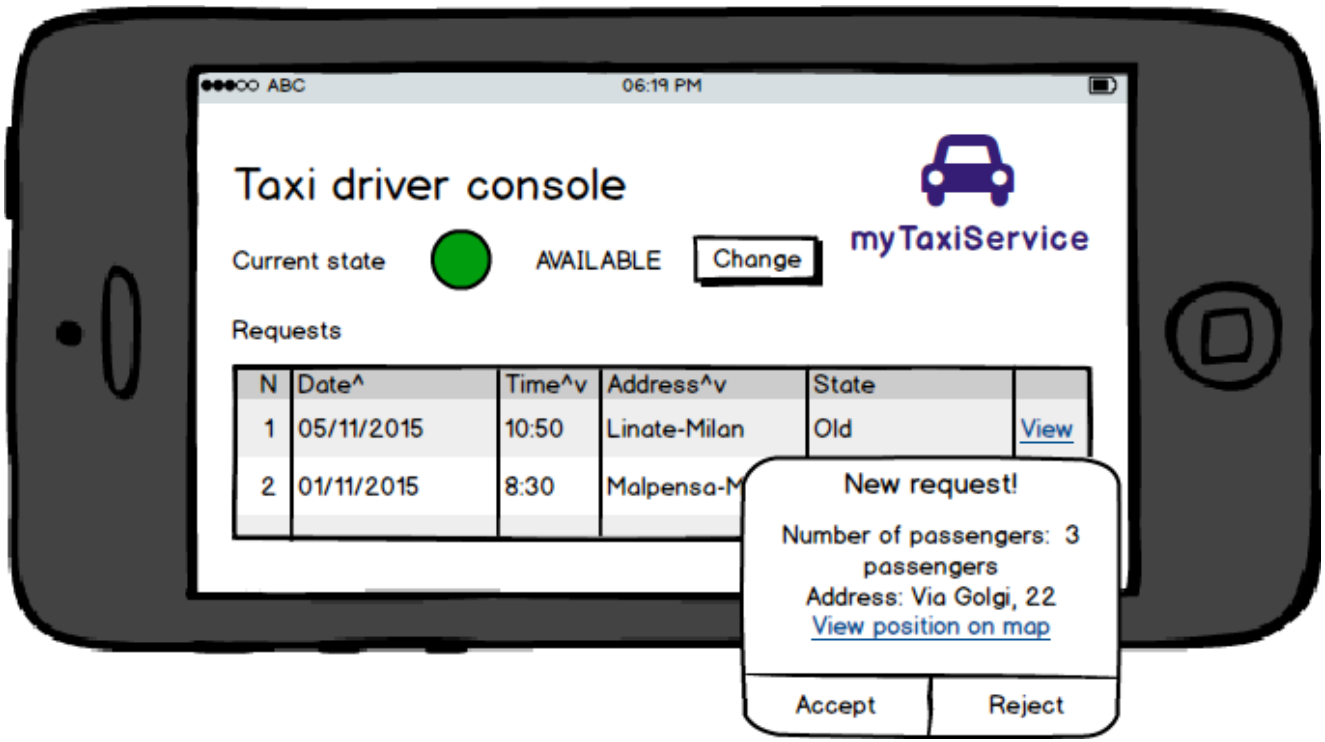
TMA interface design

UX diagram



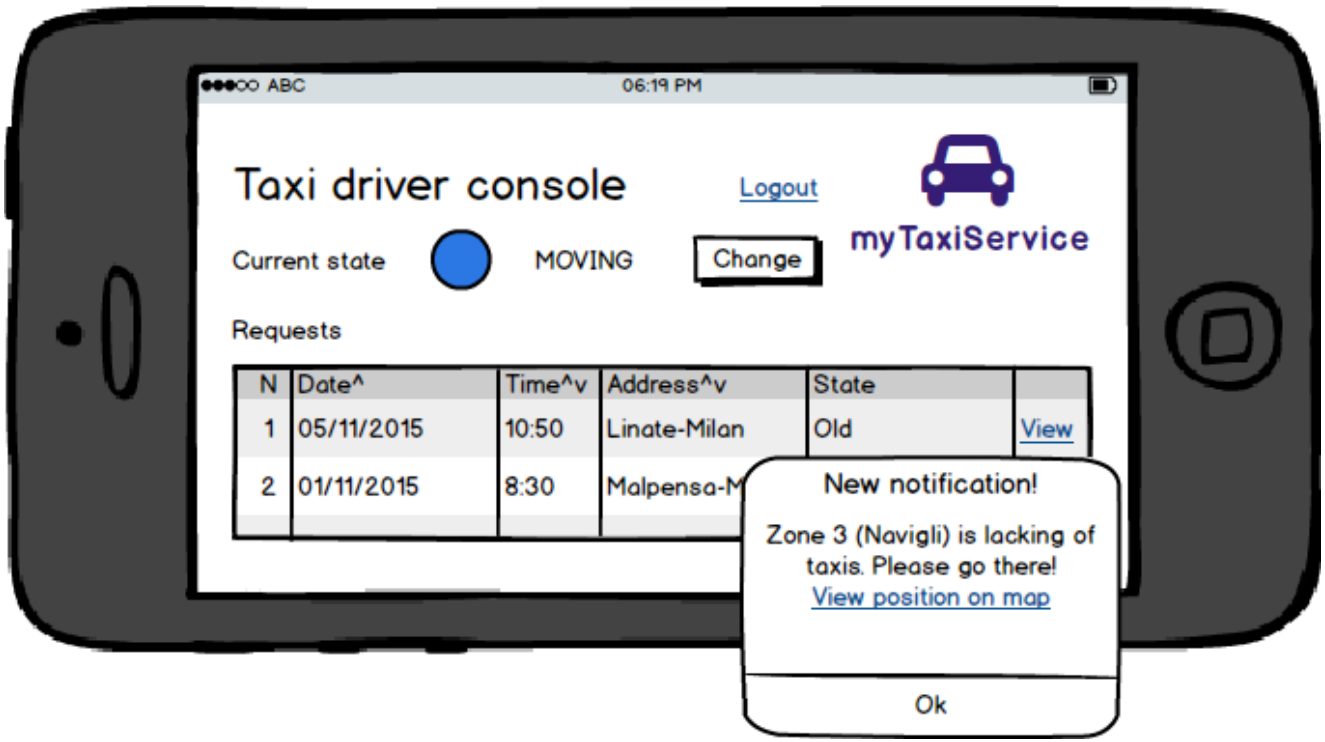
TMA interface design

Mockups - 1

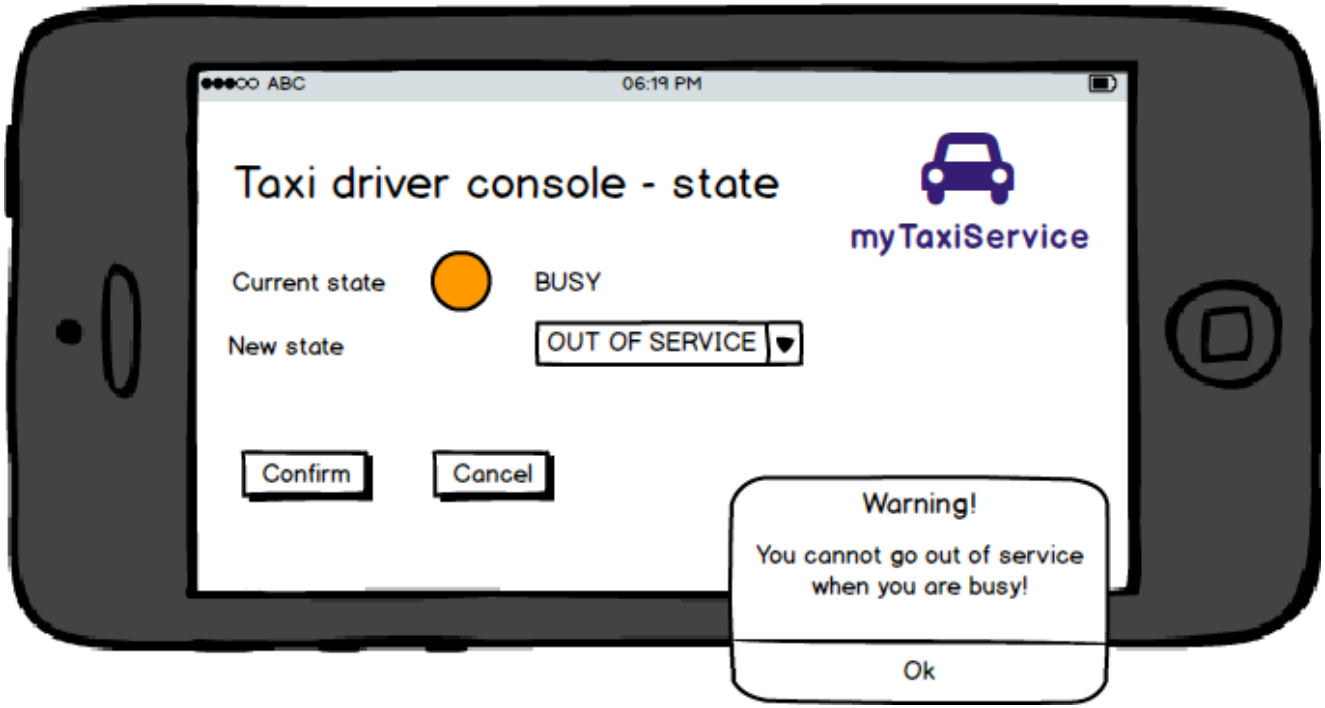


TMA interface design

Mockups - 2



TMA interface design
Mockups - 3



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Questions