

TRANSPORTATION ORDER MANAGEMENT SYSTEM



Student: Efthymios Chatziathanasiadis

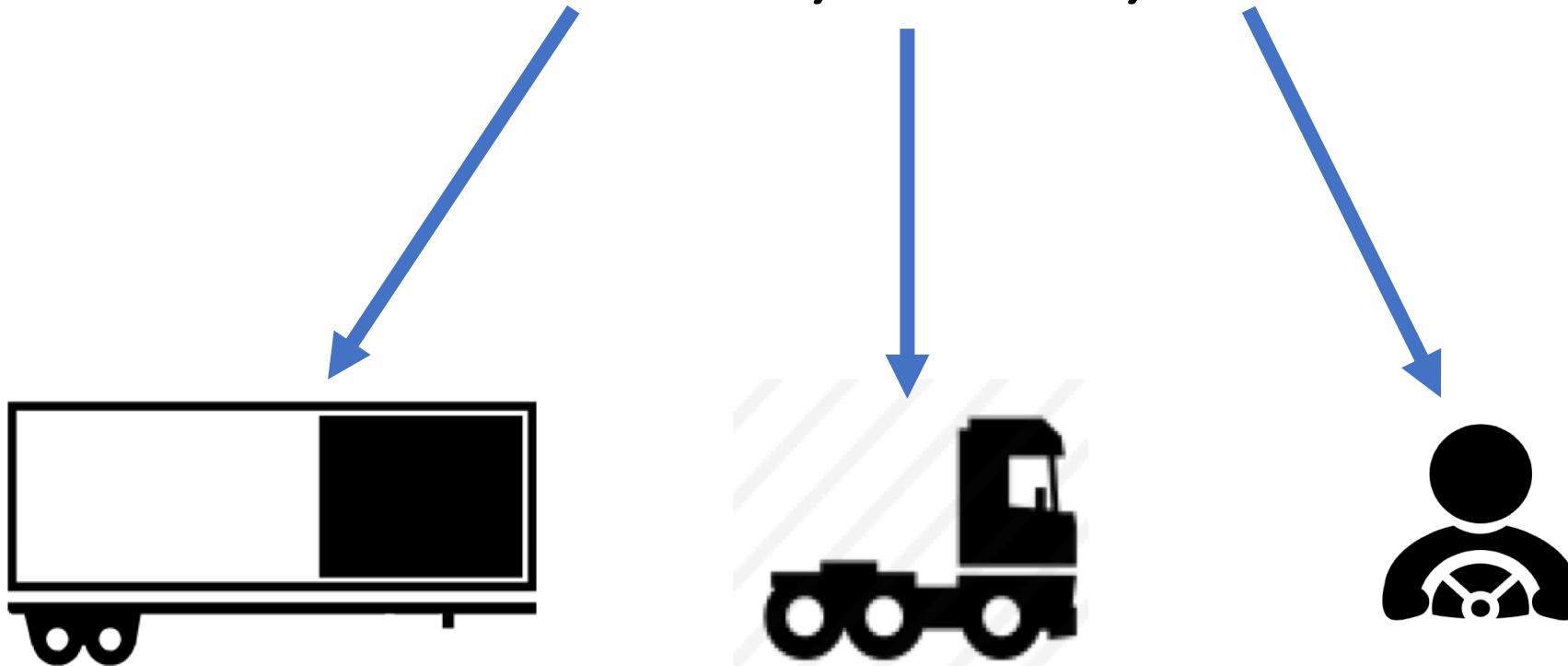
Supervisor: Dr. Nikos Tzevelekos

The client



- Transport company
- Specializes in the transportation of cargo across Europe.
- Has depots across Europe.
- Has a fleet of trailers, trucks and drivers
- Has a fixed set of customers, where each customer has a fixed set of depots across Europe.

Client's fleet: Trailers, trucks, drivers



How do they operate?

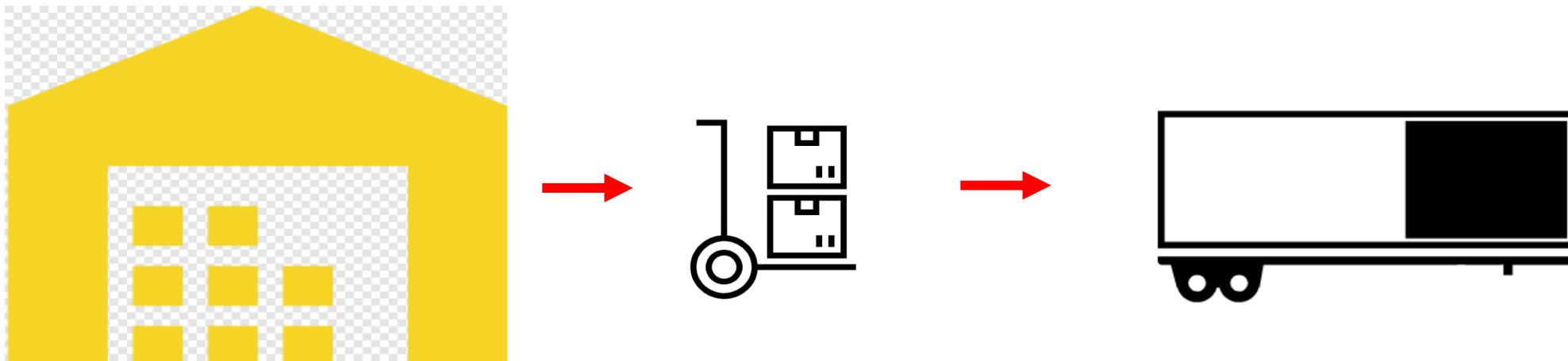
1) LOAD

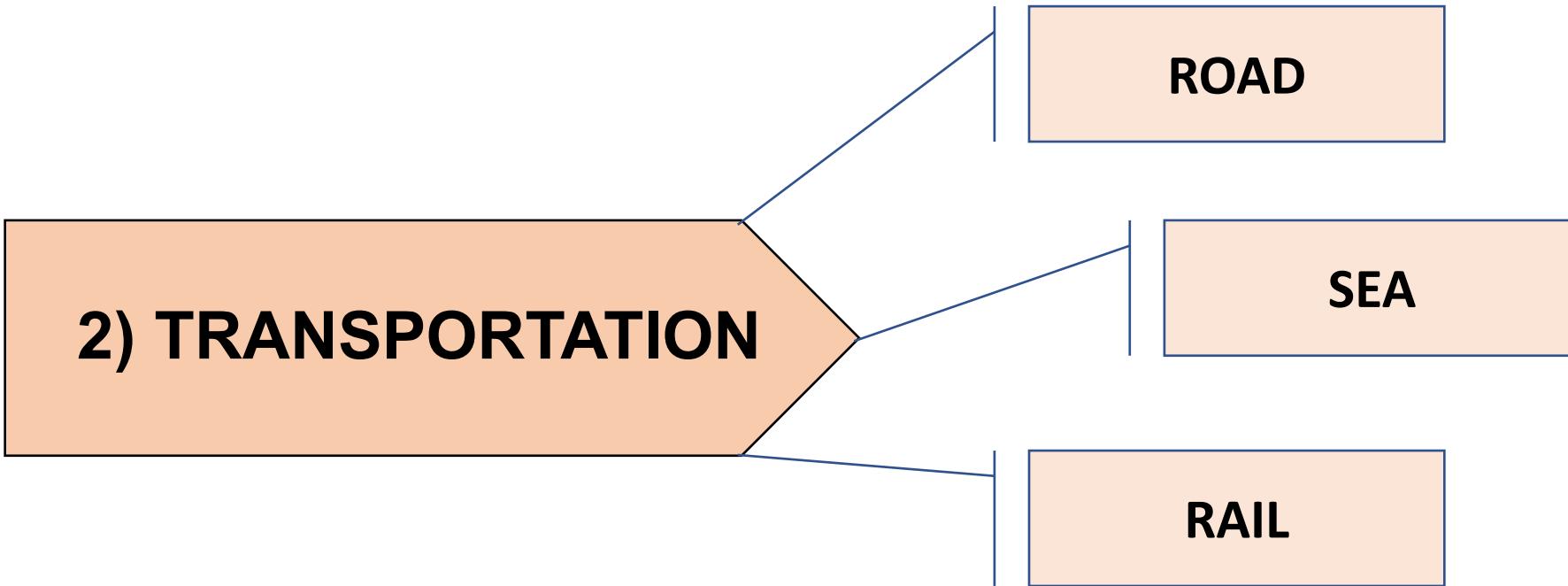
2) TRANSPORTATION

3) UNLOAD

1) LOAD

- Load goods from customer's depots on client's trailers.





2) TRANSPORTATION

ROAD

- **Road transportation** of a trailer is facilitated by client's trucks and drivers, which hook the trailer and move it through routes.



2) TRANSPORTATION

SEA

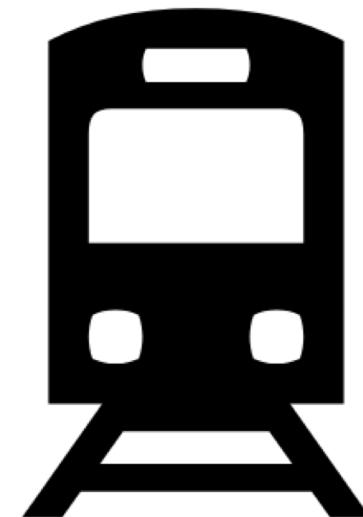
- **Sea transportation** is facilitated by external ferry carriers. The client's trailers are loaded on ferries from port to port.



2) TRANSPORTATION

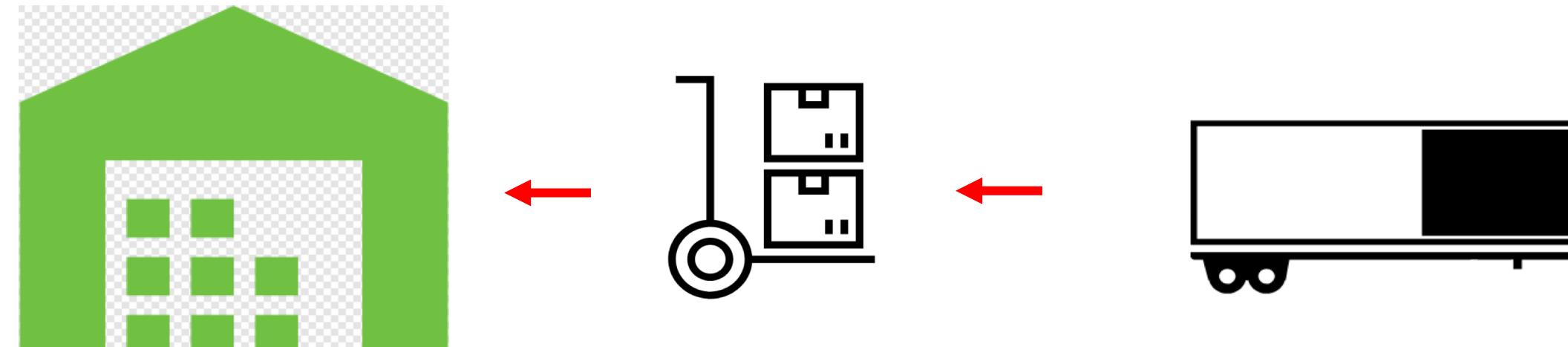
RAIL

- **Rail transportation** is facilitated by external train carriers where client's trailers are loaded on trains from terminal to terminal.



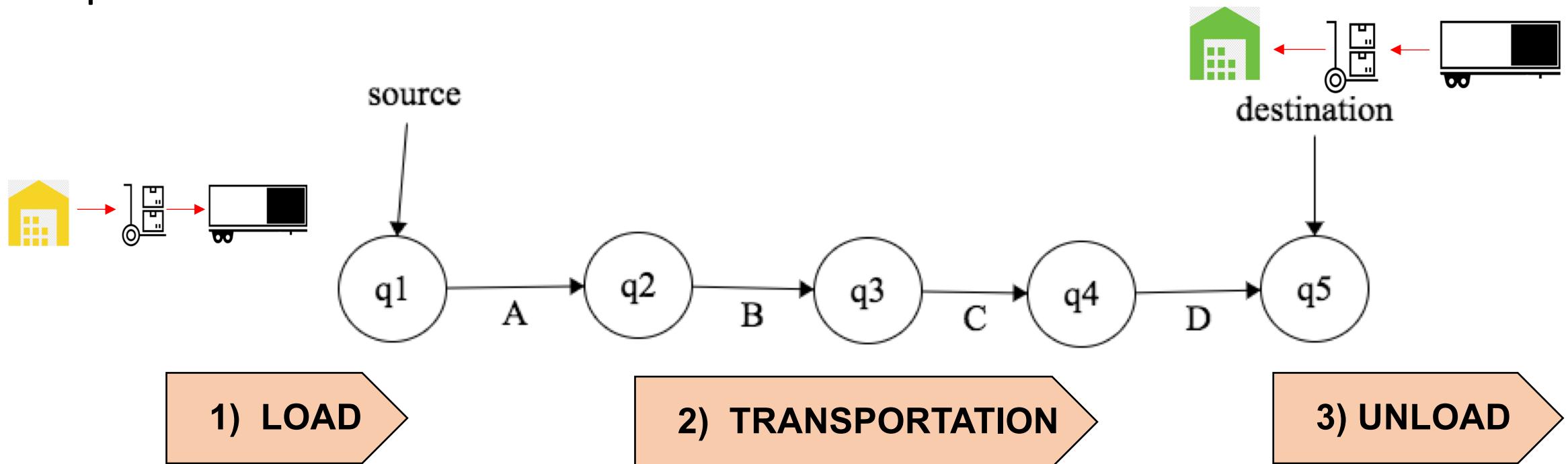
3) UNLOAD

- Unload goods off the client's trailer to client's depots.



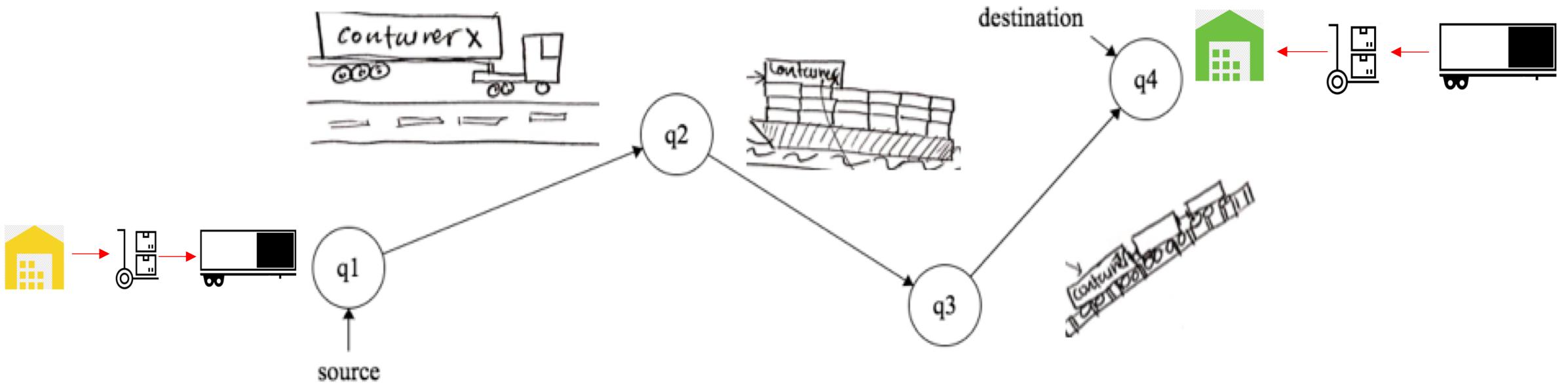
Between customer's depot – client's depot

- Routes may require multiple modes of transport
- Routes consist of subsets called dispositions
- Each disposition defines how the transportation will take place for a particular subset of the route



Example: Order's route with multiple modes

- (q1-q2) disposition is handled by a carrier through **road transport**
- (q2-q3) disposition is handled by a carrier through **sea transport**(trailer is loaded on the ferry boat)
- (q3-q4) disposition is handled by a carrier through **rail transport** (trailer is loaded on the railway)



Who/What does a disposition involve?

- **The carrier**, that handles the transportation through the particular subset of the route
- (if the carrier is the client) **The client's truck and driver** who transport the trailer through the subset of the route
- **Source and destination stations** of the subset
- **Time frame** = start and finish time

Who/What does a customer's order involve?

- **The trailer** that will carry the customer's goods from s to d
- **Source location:** Customer's depot where loading of goods is effected
- **Destination location:** Client's depot where unloading of goods is effected
- **The time frame** during which the order should be executed (i.e. start and finish date)
- **The route:** The sequence of dispositions that the trailer will travel through

Order planning process

- Prior the execution of an order, planners have to plan the following tasks:

1) Sales

2) Routing

3) Scheduling

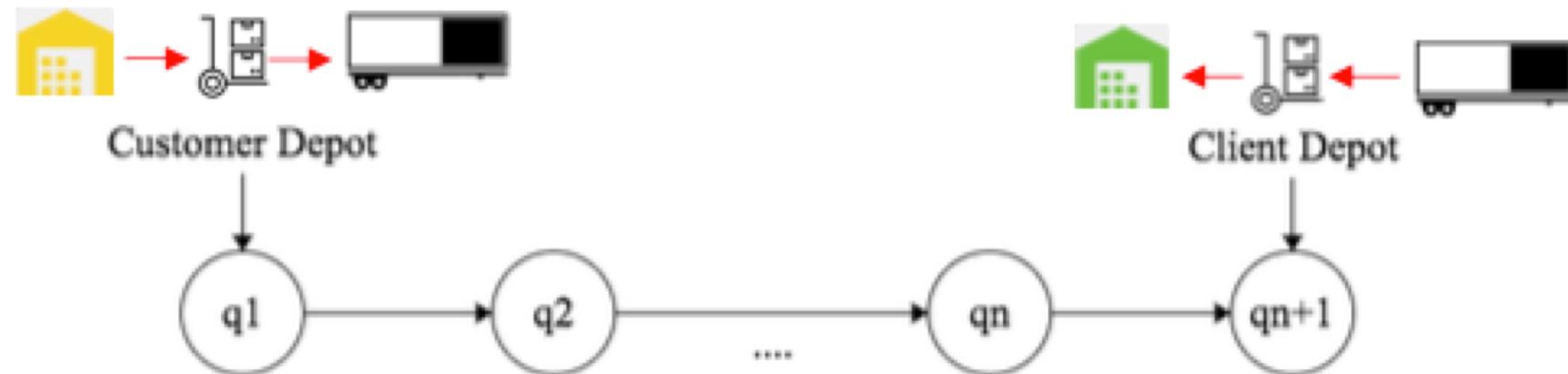
1) Sales

Sales – Task 1

- Planners perform sales, in order to bring customer orders to the company

Routing of order – Task 2

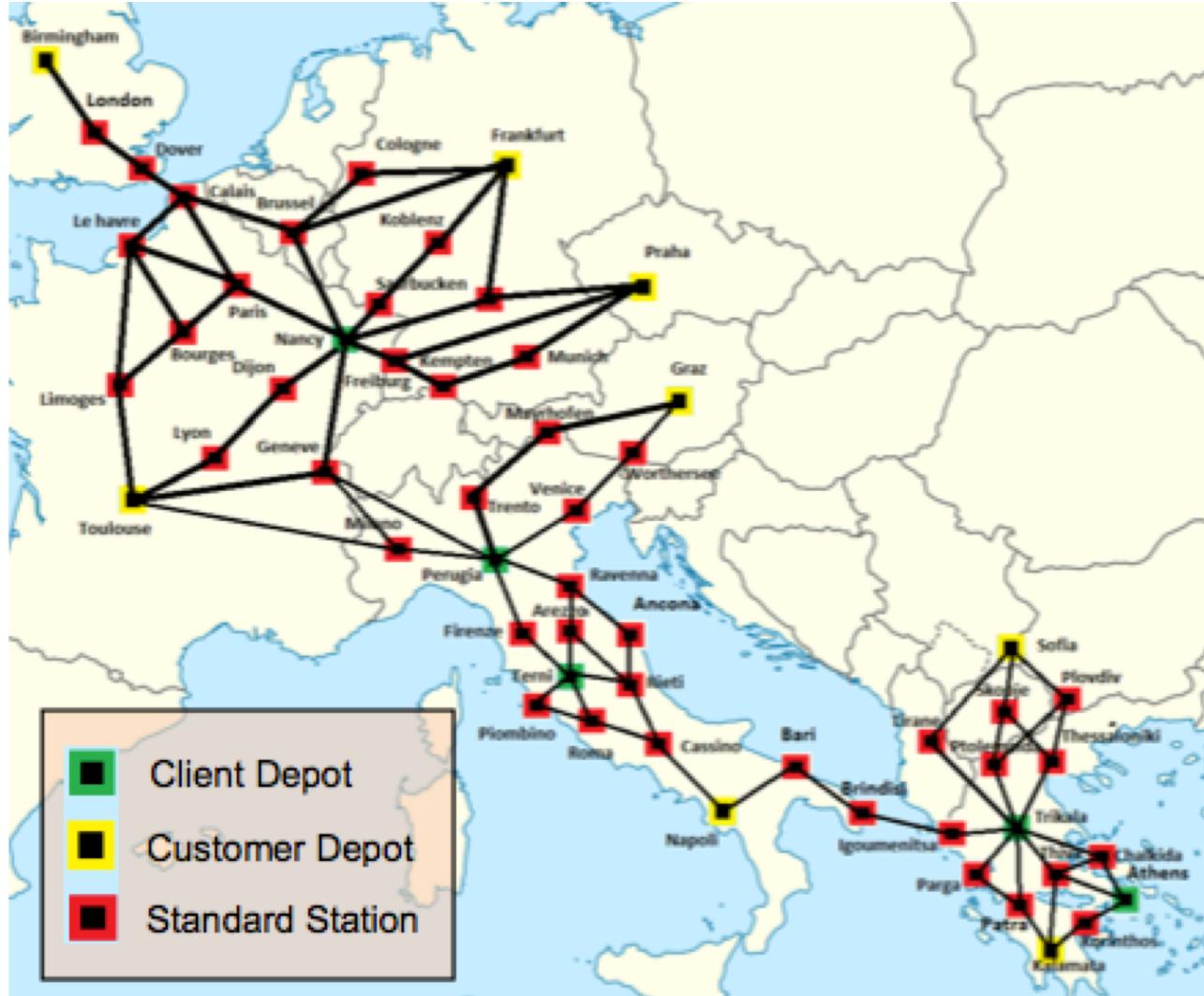
- Routing involves finding a path that:
 - Starts from the customer's depot (i.e. the place where cargo is loaded on the trailer)
 - Finishes at a client's depot (i.e. the place where cargo is unloaded off the trailer).
 - And, in between, has a series of stations that the trailer should travel through



Problem A: Find the shortest path from customer's depot to client's depot

2) Routing

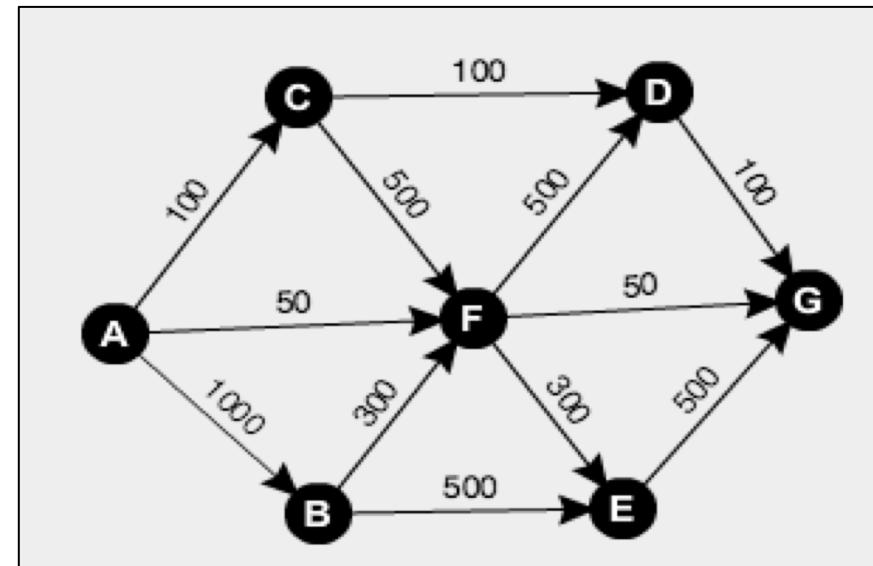
- Client operates within a constrained network of standard:
 - Stations
 - Routes
- Client expanded network
- Multiple paths exist between:
 - Customer's depots
 - Client's depots
- Complex routing -> high cost
- No routing tool e.g. Google Maps



Problem A Solution: Dijkstra algorithm

2) Routing

- The client's transportation network represented as a directed graph $G(V,E)$ where:
- V is a finite set of vertices(i.e. stations) and
- E is a set of directed edges(u, v).
- Each edge e has a weight indicating the distance it takes to traverse e



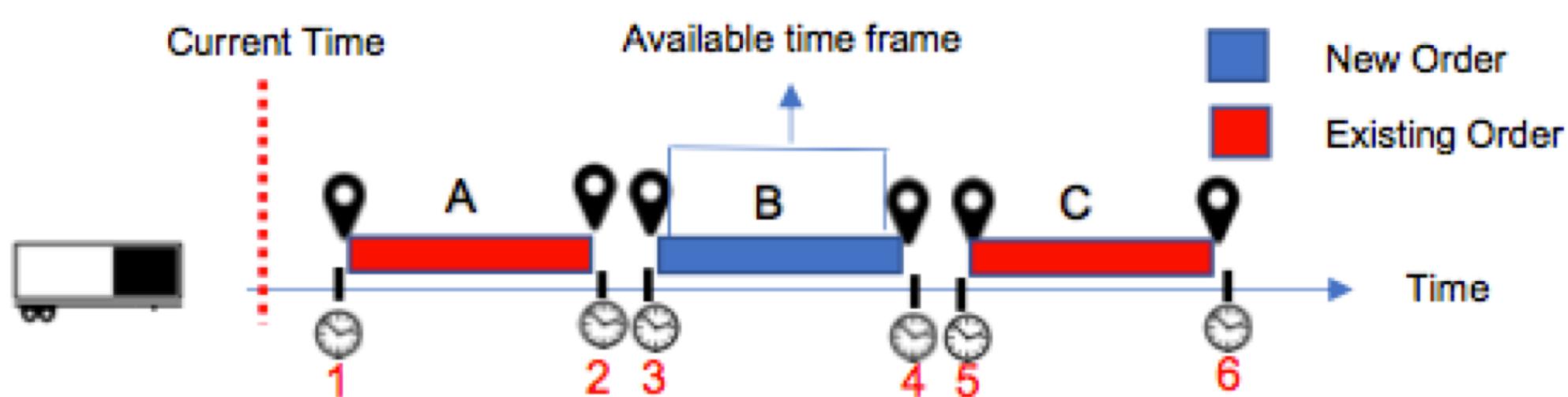
Scheduling – Task 3

After the optimal route has been found, planners must:

- Assign an **available trailer** to carry the customer's cargo from customer's depot to client's depot(i.e. whole route)
- Assign carriers to each disposition of the route
- For the dispositions where carrier is the client itself, planners must also:
 - Assign an **available driver and truck** to transport the trailer for the particular disposition

What does “available trailer” for an order mean?

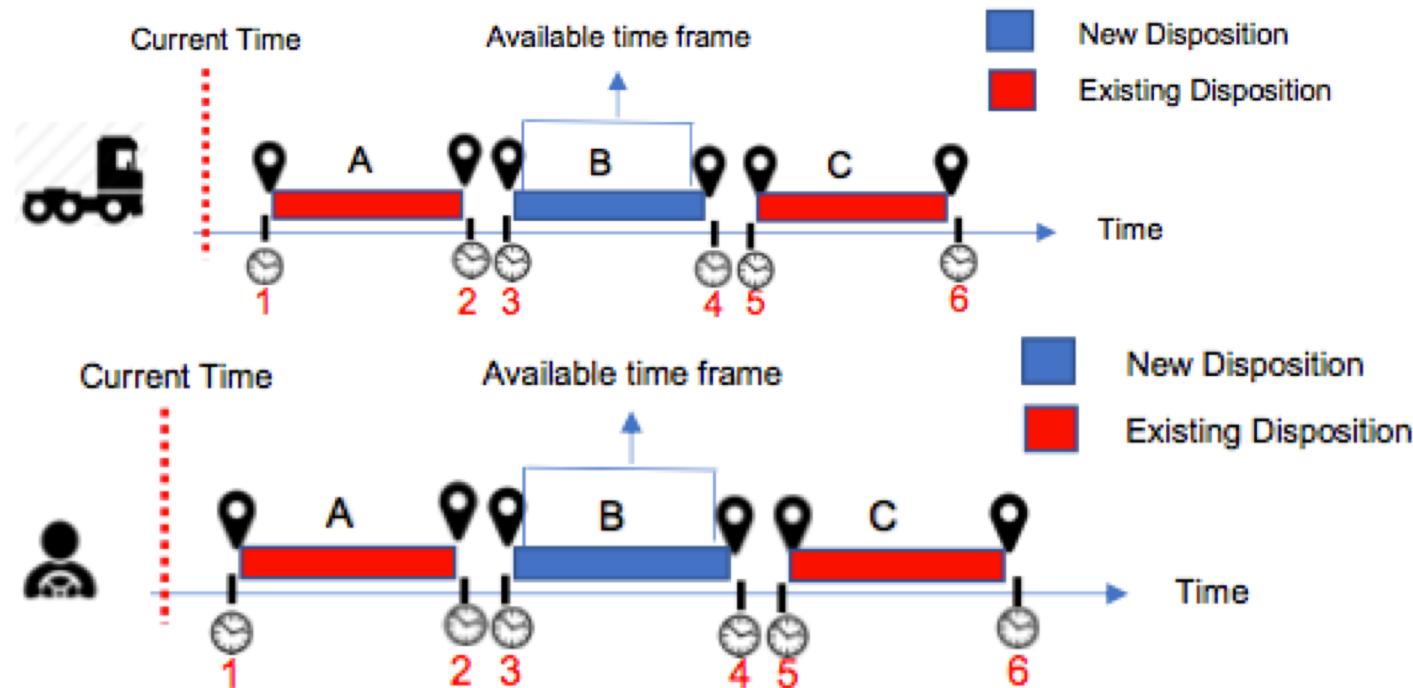
- A trailer is available for a new order's time frame, if it satisfies the following requirements:
 - It has not been assigned to other orders for the new order's time frame.
 - It is located near the source station of the order's transportation route for the new order's time frame.



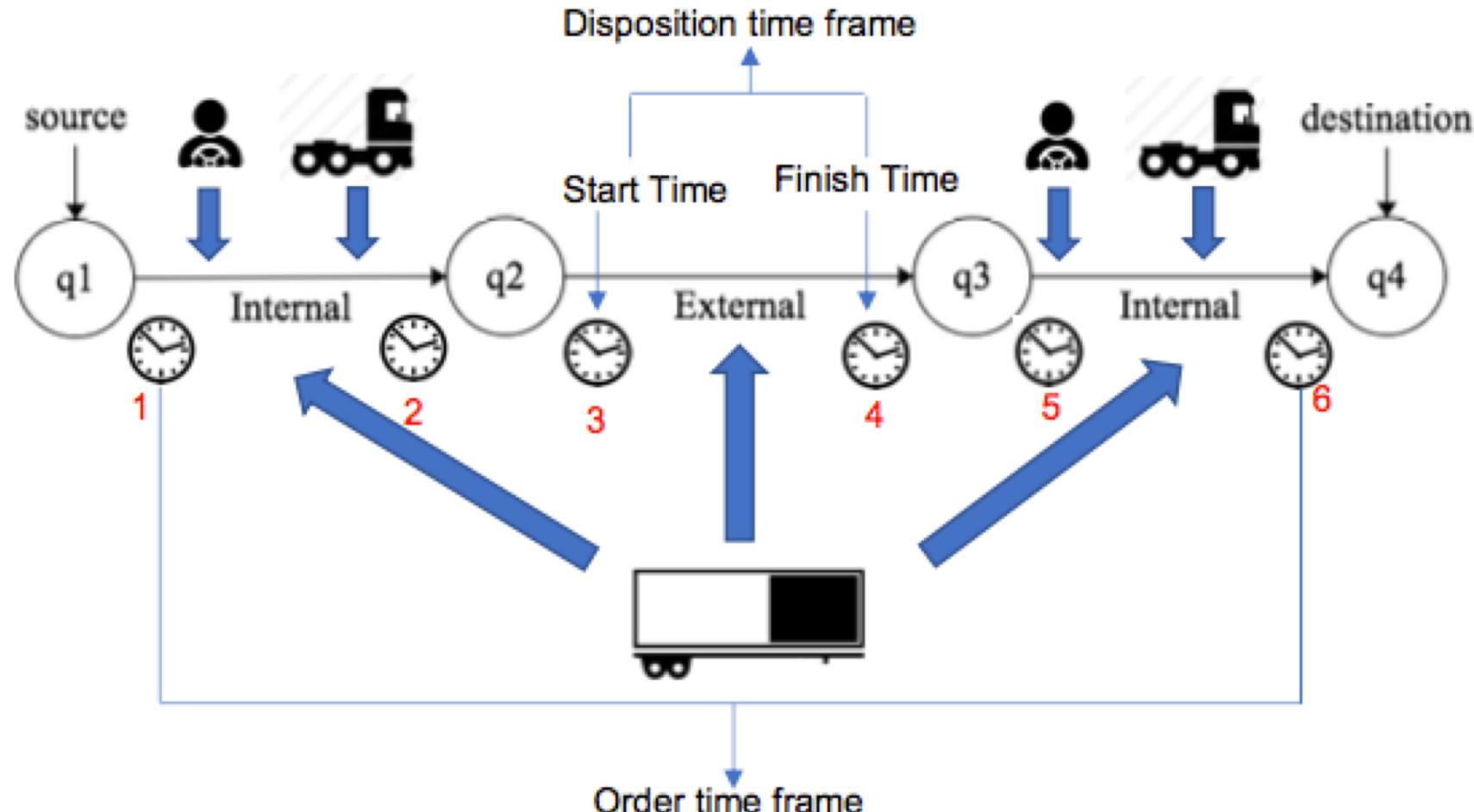
What does “available truck, driver” for a disposition mean?

3) Scheduling

- Truck and driver objects are available for a new disposition’s time frame of a transport route, if they satisfy the following requirements:
 - They have not been assigned to other dispositions for the new disposition’s time frame.
 - They are located nearby the source station of the disposition for the new disposition’s time frame.



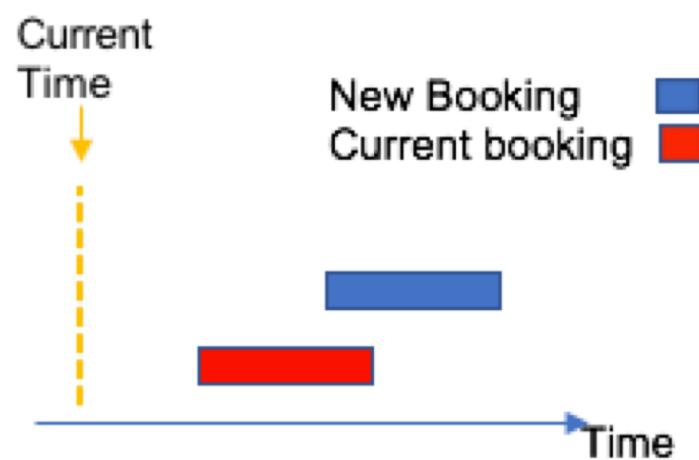
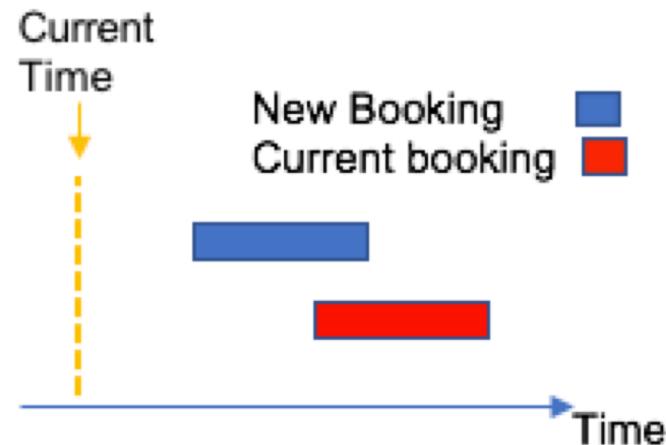
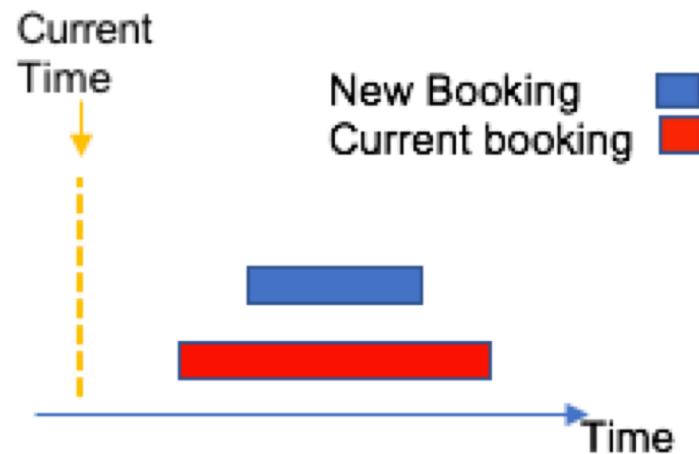
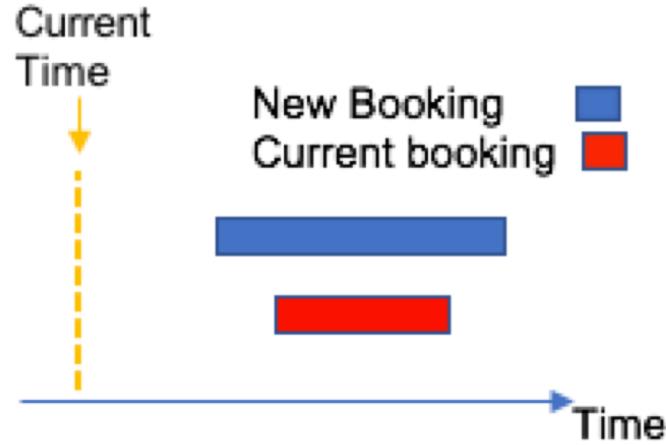
Problem B: Find available fleet (i.e. Trailer, Truck, Driver) for various time frames of a transport route.



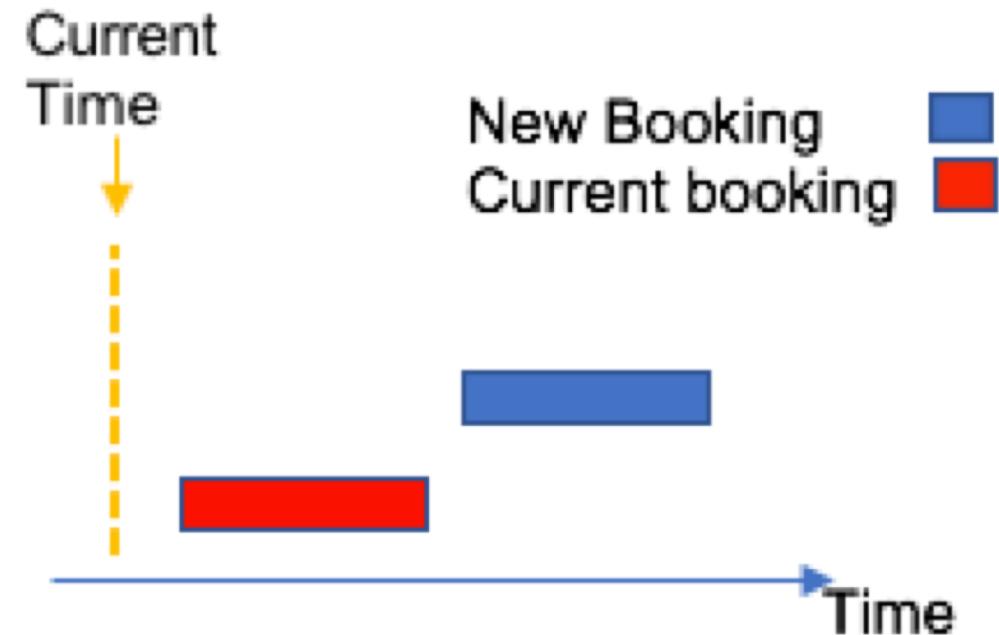
Problem B Solution: Tailored algorithm

- **Algorithm idea:** Given a new booking's time frame, find a list of objects(trailer, driver & truck) that are available for that given time frame.
- Input: new booking's time frame, booking's source location
- **Step A:** Find objects(i.e. trailer, truck or driver) nearby the booking's source location
- **Step B:** For each object nearby, find its existing bookings prior to the new booking's time frame
- **Step C:** For each existing booking, **check** if its time frame **clashes** with the new booking's time frame. If there is no clashing, add object to available list.
- Output: available list of objects.

Clash-checking returns true in these cases



Clash-checking returns false in these cases



Summary

TOMS software solution makes the planning process of orders more efficient by:

- Routing orders through the shortest path
- Preventing scheduling errors through finding available fleet for various time frames of the order's transport route.

Thank you !