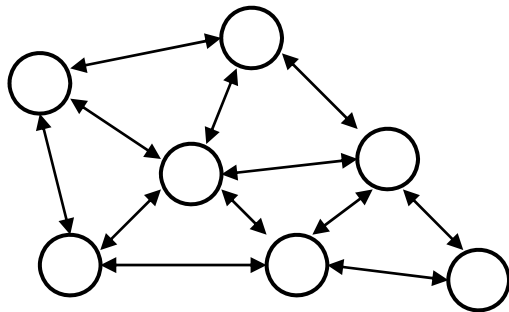# *Guest Lecture on Traffic Models*
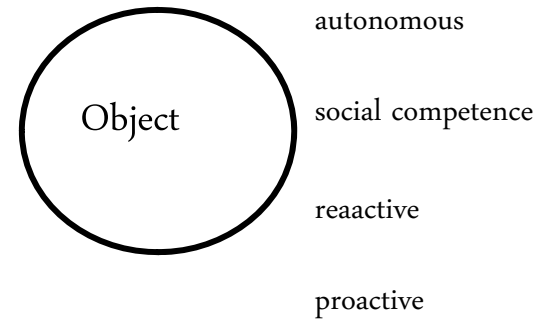
Sebastian Iwanowski
FH Wedel, University of Applied Sciences
Germany

Software technology: Agent oriented software
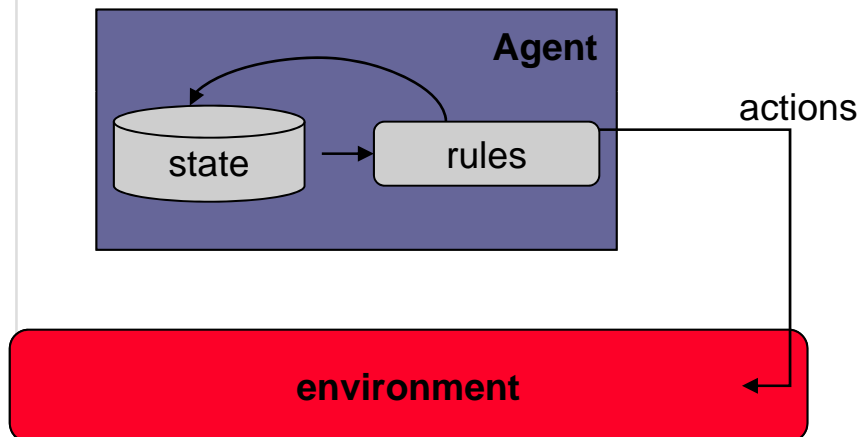
Multi agent system:

Software agent:

Object

autonomous

social competence

reaactive

proactive

Software technology: Agent oriented software

Agent property: Proactivity (goal-oriented)

Agents do not only react to impulses of their environment, but do have an internal state which makes them pursuing an own goal.

=> They take the **initiative**

*„The difference between an automaton and an agent is a somewhat like the difference between a dog and a butler. If you send your dog to buy a copy of the New York Times every morning, it will come back with its mouth empty if the news stand happens to have run out one day. In contrast, the butler will probably take the **initiative** to buy you a copy of the Washington Post, since he knows, that sometimes you read it instead."*
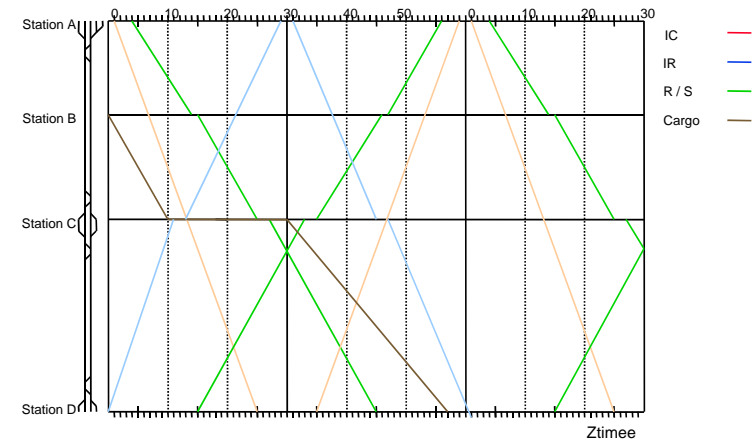
Le Du

Application: Railway traffic coordination

Which train is allowed to use which railway segment at what time?

graphical timetable construction

Disposition level:

      Coordinating all trains

      For all railway segments
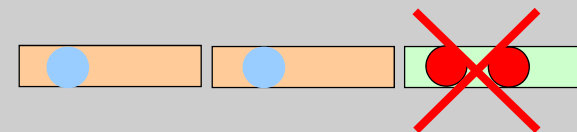
Security level:

      Securing a railway segment:

      Only 1 train per time slot

      will not be altered here

blocking principle

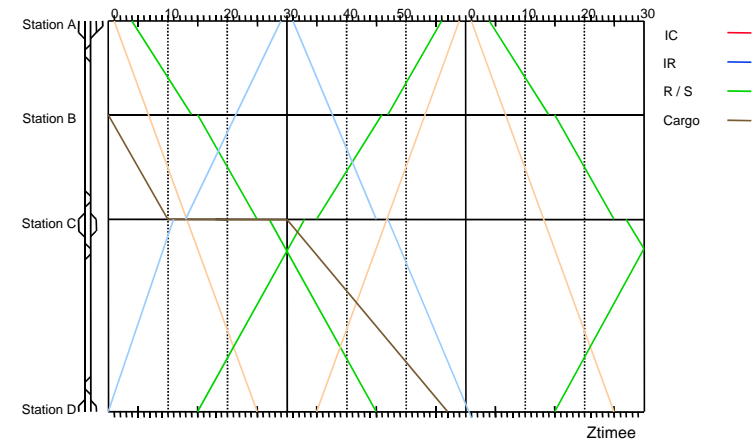location-based signalling   train control systems

Application: Railway traffic coordination

Which train is allowed to use which railway segment at what time?

graphical timetable construction

Disposition level:

   Coordinating all trains

   For all railway segments

state-of-the-art: Time tables and route assigments are planned

in a central disposition phase prior to journey.

Switches are set by central coordination

Problem: inflexible with respect to:

   •   unforeseen spontaneous changes ("disturbances")

   •   spontaneous changes of requirements

Application: Railway traffic coordination

Get rid of central control !   Favour distributed management!

Method: Trains set switches themselves according to their need

                           Trains negotiate with each other about free slots

Already in reality: Tramways   by man
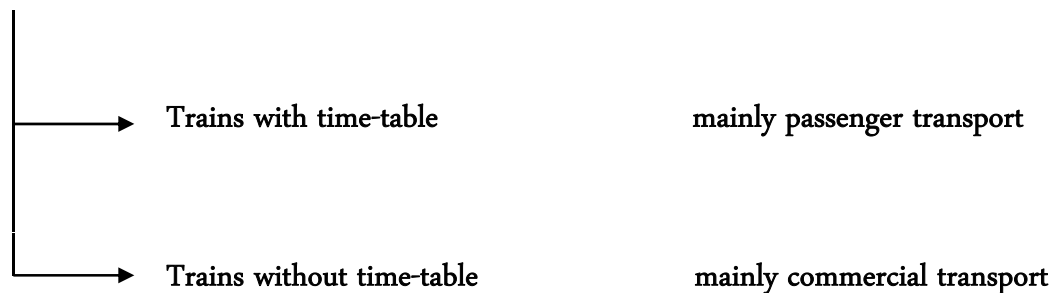   (with electronic support)

New concept for: Long-distance traffic   using software agents

                                → Trains with time-table   mainly passenger transport

                                → Trains without time-table   mainly commercial transport

Application: Railway traffic coordination

Negotiation method: Electronic auction

Example: Zürich Central Station

Rail Segment [SE]

I bid for SE

I need SE as optimal route

I increase bid for SE
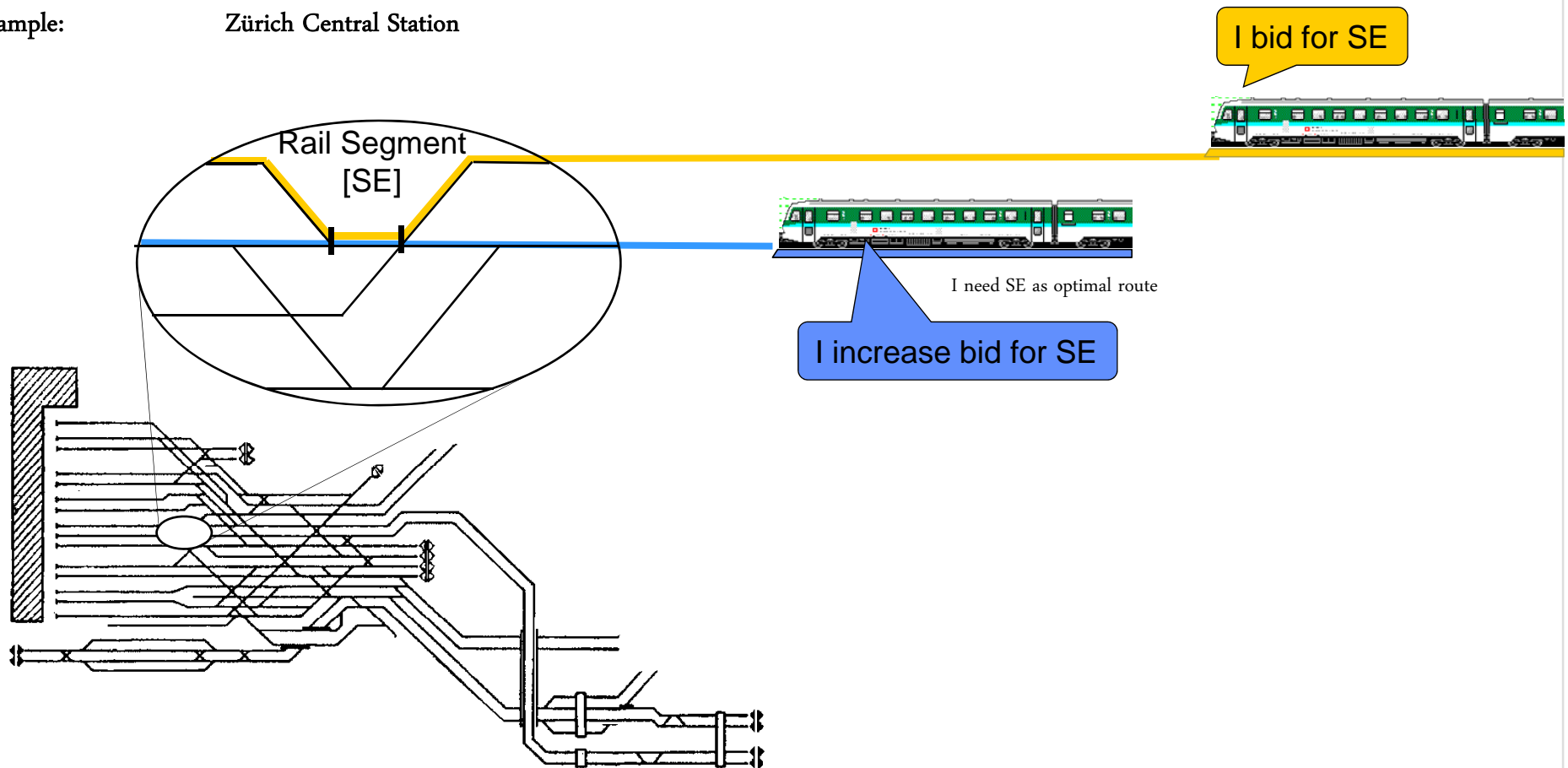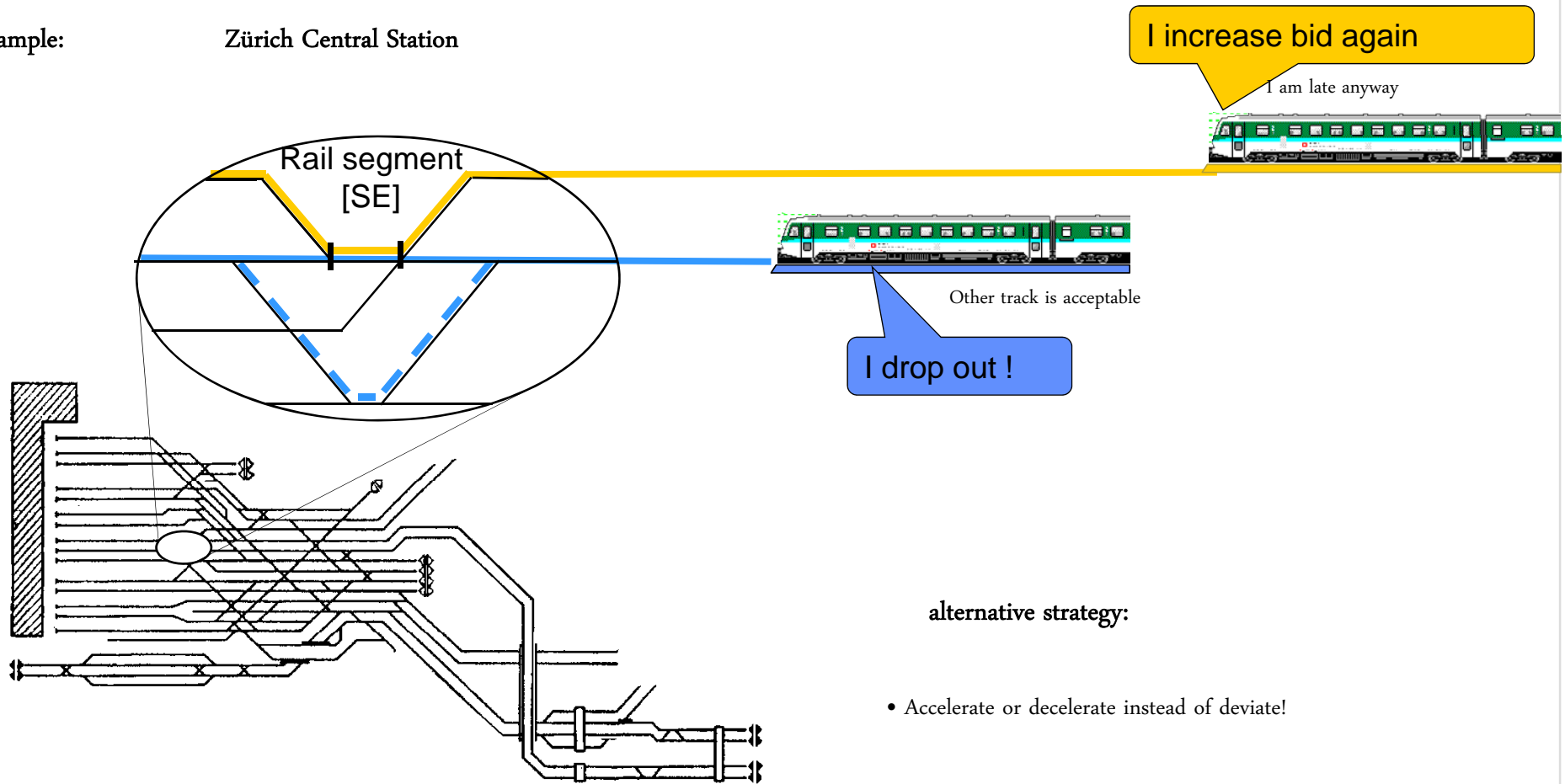
Application: Railway traffic coordination

Negotiation method: Electronic auction

Example: Zürich Central Station

Rail segment [SE]

I increase bid again

I am late anyway

Other track is acceptable

I drop out !

alternative strategy:

• Accelerate or decelerate instead of deviate!

Application: *Road* traffic coordination

What is different with road vehicles ?

- Vehicles may not be forced to deviate to a different segment individually.

- There is a strict distinction between net user and net provider.

- Several vehicles may be admitted at the same segment at the same time.

- There is a higher variety of alternative routes.

Application: Road traffic coordination

Dynamic **route navigation for roads**

Route navigation systems currently available

- make route suggestions, considering the _current traffic situation_

- give all drivers with same destination at same time the same suggestions

What happens if the majority of drivers has got
such a navigation system?

Application: Road traffic coordination

Problem

Congestions shift from one place to the other,

because all drivers try to avoid them the same way

Solution

Coordinate drivers

making different suggestions

Problem

Drivers do not like to get domineered

Solution

Let drivers get impact in decision
giving priorities and different weightings

Application: Road traffic coordination

Auction-based traffic coordination

Road network is partitioned into road segments with predefined vehicle capacity for a given time slot

The using rights for road segments for certain time slots will be auctioneered to vehicles in periodic auction rounds. The vehicles use a *virtual budget* which they are supplied with at beginning.

The vehicles participate in the auctions by individual software agents. Communication with the auctioneer is performed automatically without necessity of driver interaction.

This makes traffic management primarily a software problem !