Multi level approach in the feasibility check on the train stop deployment planning

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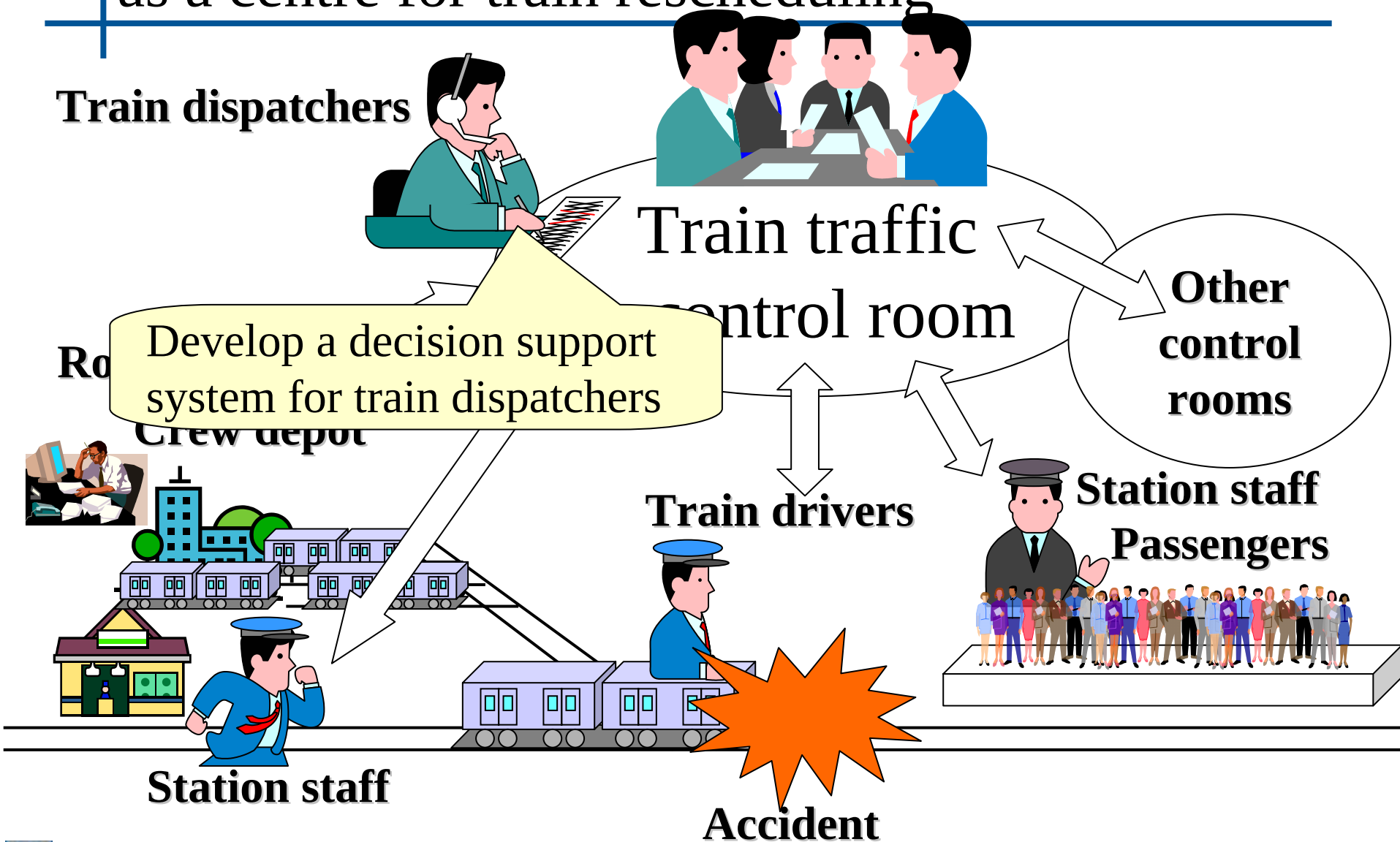
Outline

- Railways at metropolitan areas in Japan
- Train rescheduling
- Train stop deployment planning
- Basic concept of our approach
- The multi level approach
- Applying to an actual line
- Conclusion

Train traffic control room as a centre for train rescheduling



Train rescheduling operation (Main flow)

- Get information about the accident
- Make each train stop at an appropriate location
  - To keep safety
  - To make an easier rescheduling plan
  - To avoid unexpected passenger troubles
- Make a rescheduling
  - Canc
    assig
- Input eac
  Time consuming
- Tell the rescheduling plan to drivers, station staff, train depot staff and passengers => Parallel transmission

The most intellectual part

Train stop deployment planning

Locations of train stops are determined by a train dispatcher.

Requirements (1)

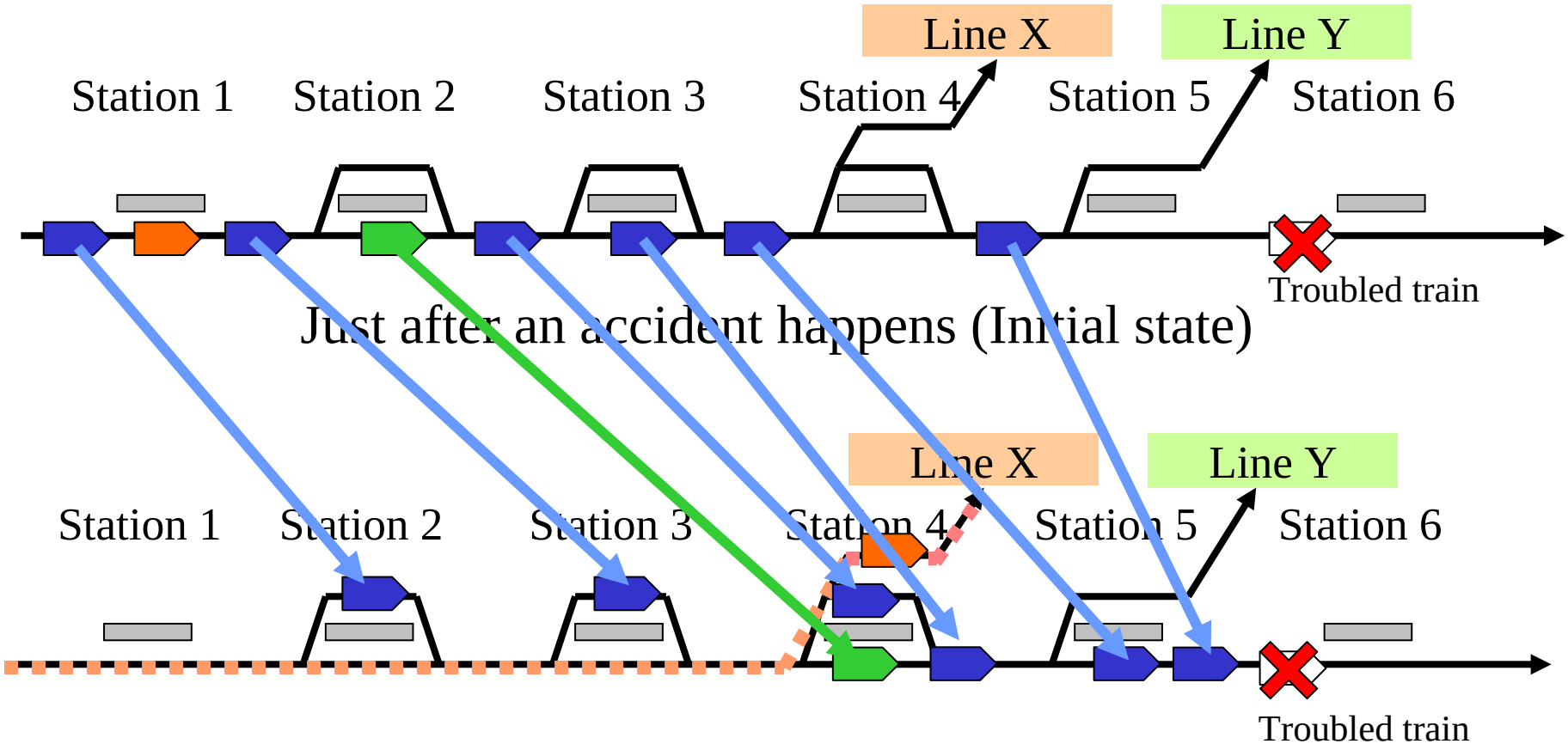
- Each passenger train is desired to stop along a platform to allow passengers get off the train to choose alternative transportation

- Trains are stopped keeping the order of operation, and the positions of trains stopped should be at almost even intervals

Requirements (2)

- Trains for another line should not be blocked
- A long train like a freight train should stop at an appropriate location such as a track at a station long enough
- To allow a train stop at a non-platform location only if it can drop all its passengers off before stopping

Train stop deployment planning

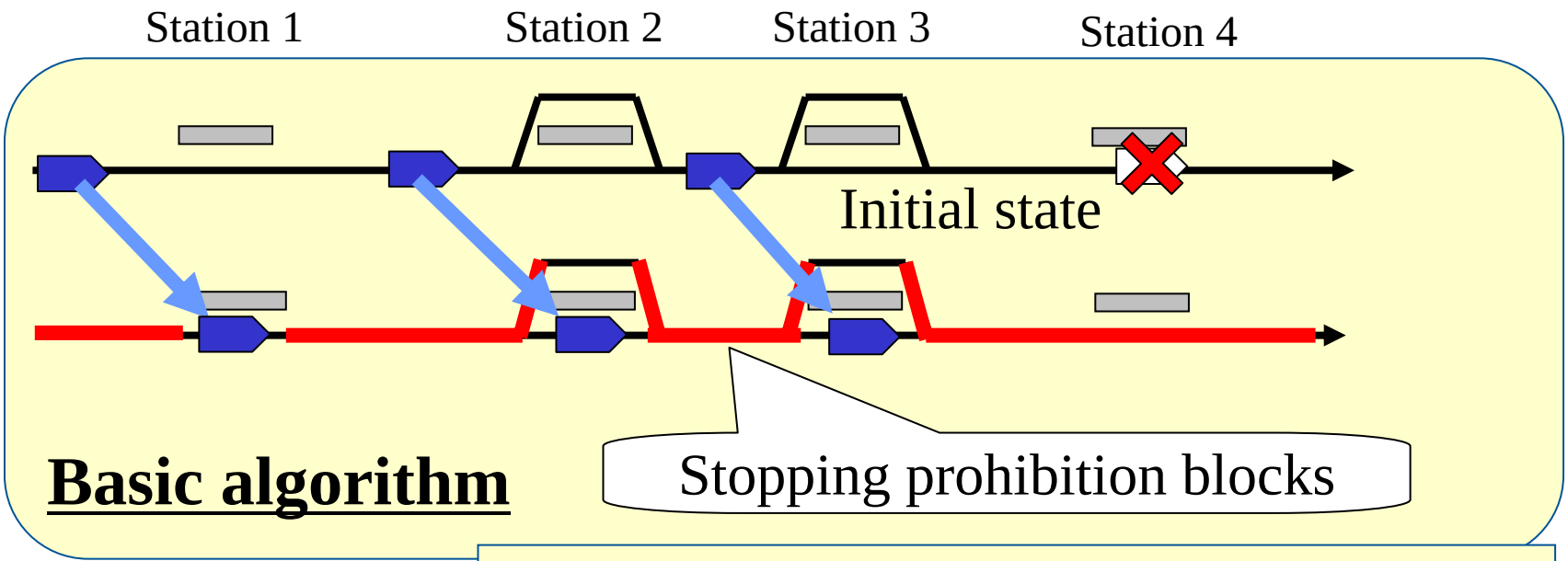


Previous work

- Petri-net approach (Reference [11])
- The approach requires a lot of parameters
  - Maximum number of firing, weight values for each track, and etc.
- The model can be very large.
  - Need to prepare an infrastructure model for each train

We want an approach that is easier to understand and easier to calculate

Basic concept of our approach



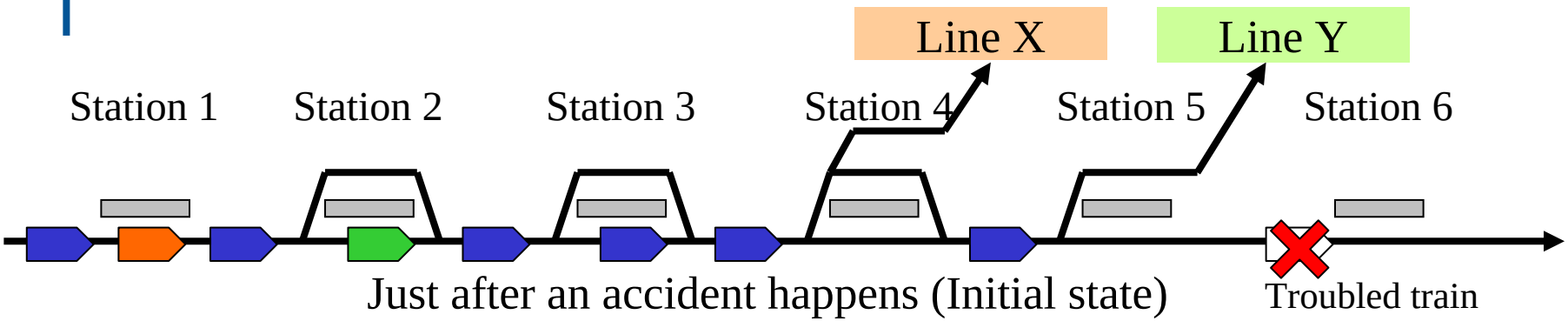
Basic algorithm

We can use the basic algorithm
to check the feasibility for a simple problem

Multi level approach

Applying the basic algorithm to a problem iteratively with modification of the problem based on the given strategy

Multi level approach example



Strategy: A list of strategic policies

Level 1: Keep routes open bound for Lines X and Y

Prohibit trains from stopping at non-platform location

Level 2: Keep routes open bound for Lines X and Y

Allow trains to stop at non-platform location if it has no passenger

Level 3: Keep a route open bound for Line X (Give up a route for Line Y open)

Allow trains to stop at non-platform location if it has no passenger

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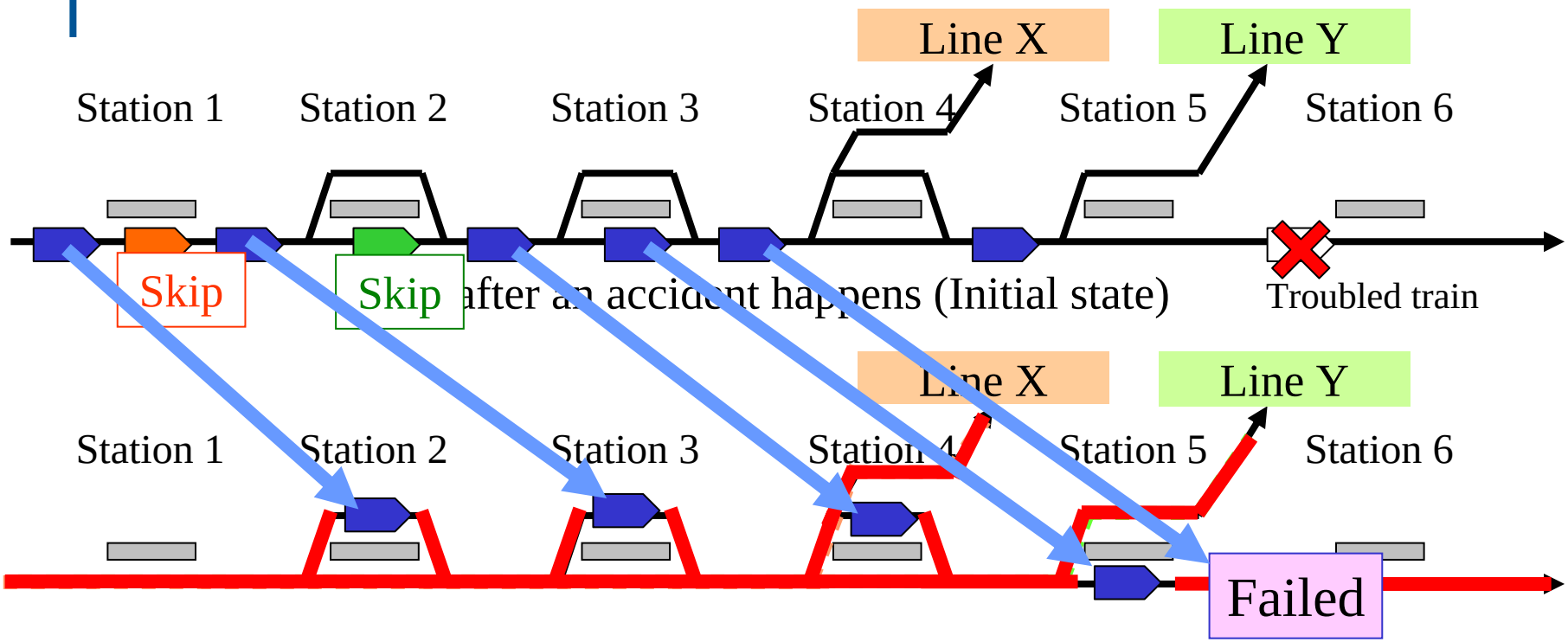
Level n: Another description for each level

Multi level approach example (Level 1)



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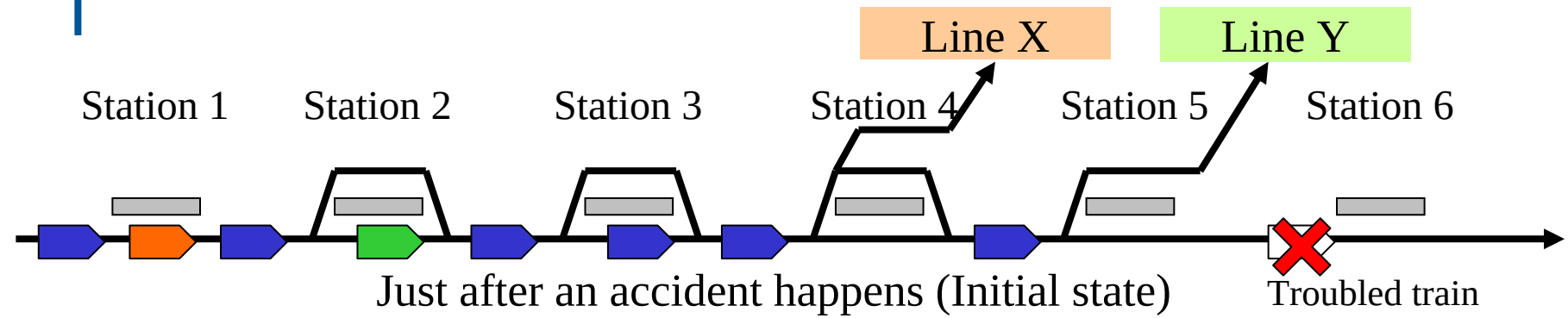
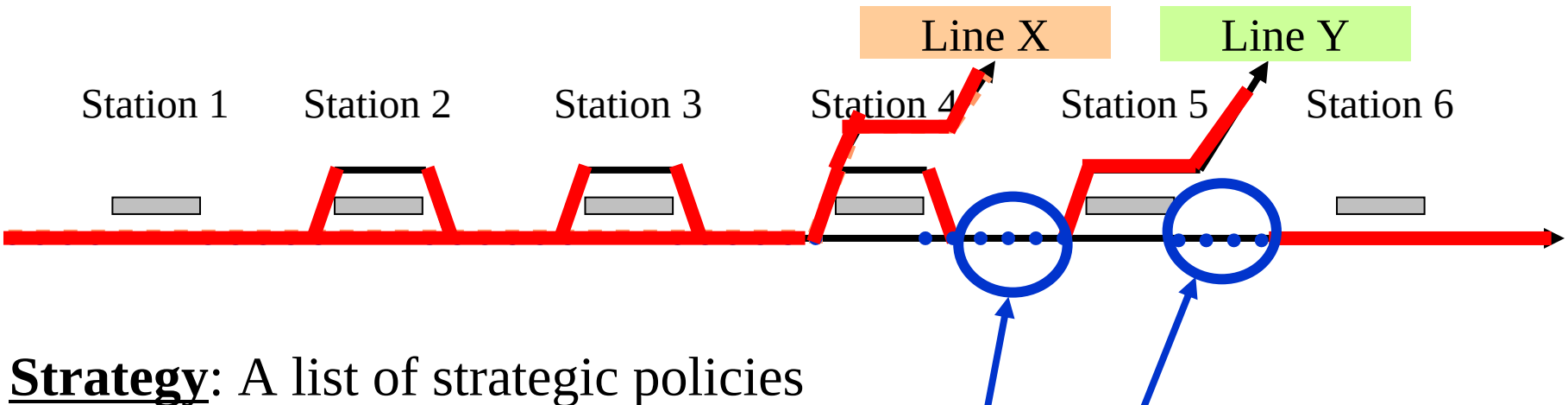
Multi level approach example (Level 3)





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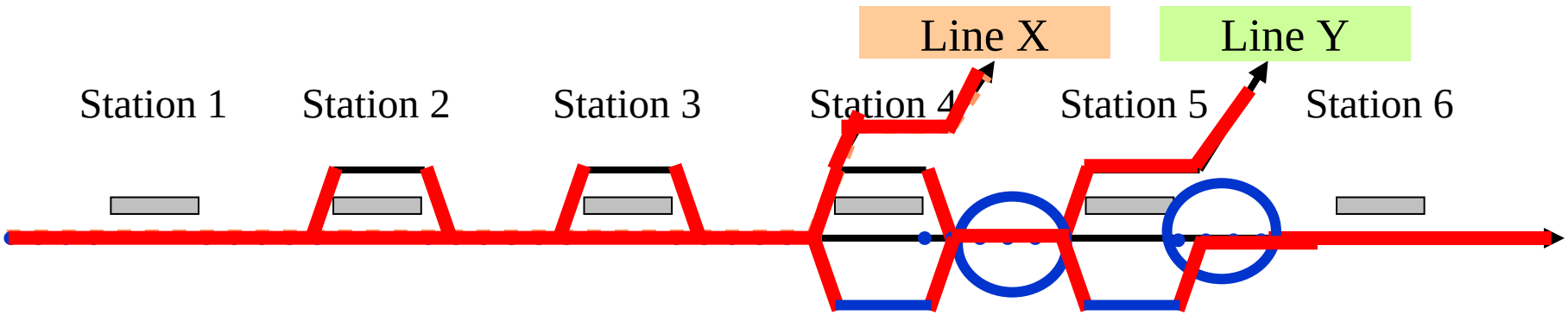
Multi level approach example (Level 3)

Dummy track

A dummy track represents an action

⇒ Once a train stops at the station,

and drop all passengers off there. Then, move out.



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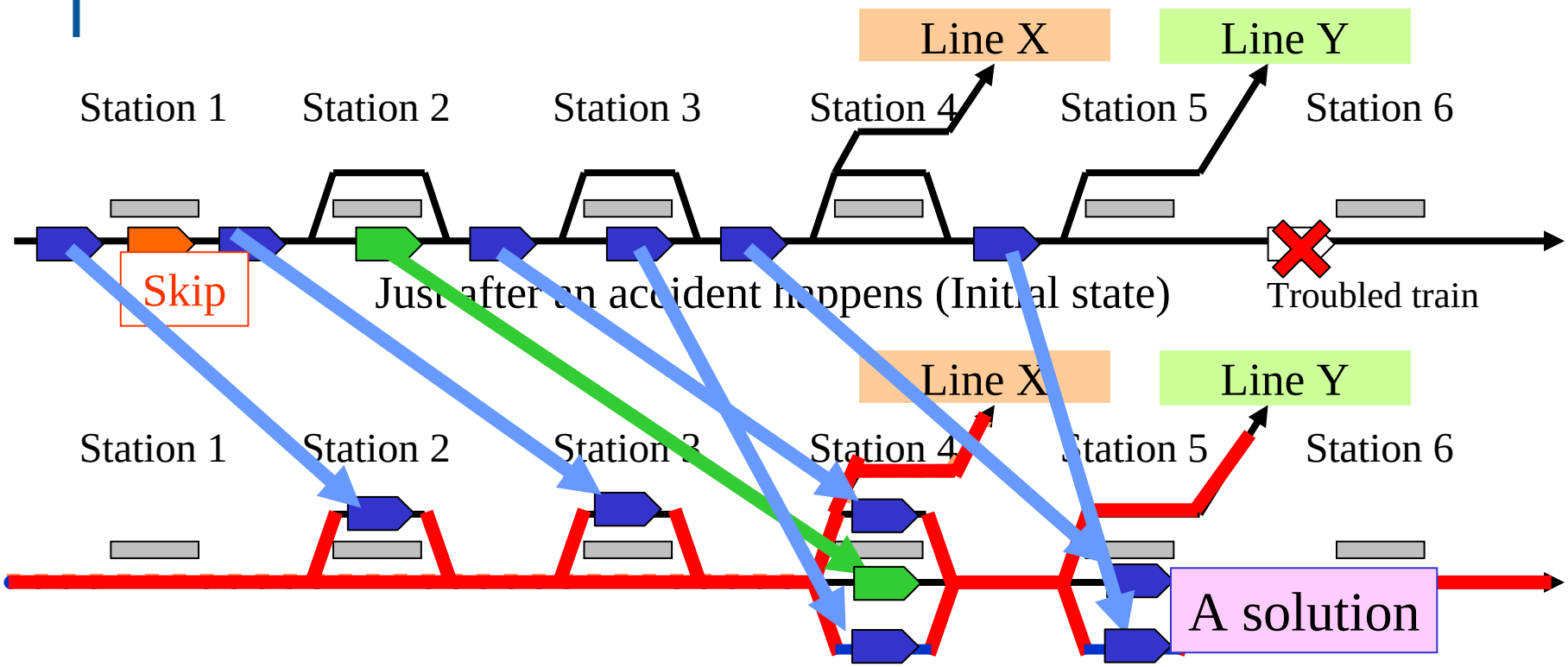

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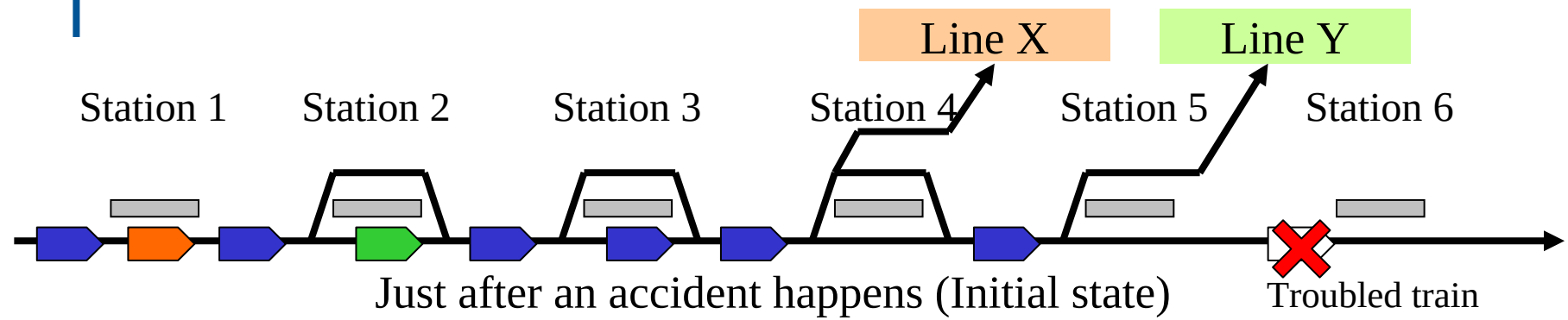

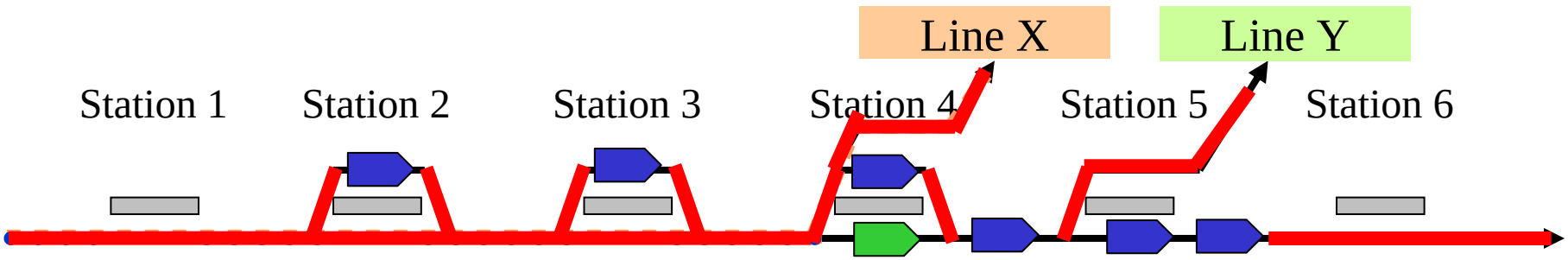

Strategy: A list of strategic policies

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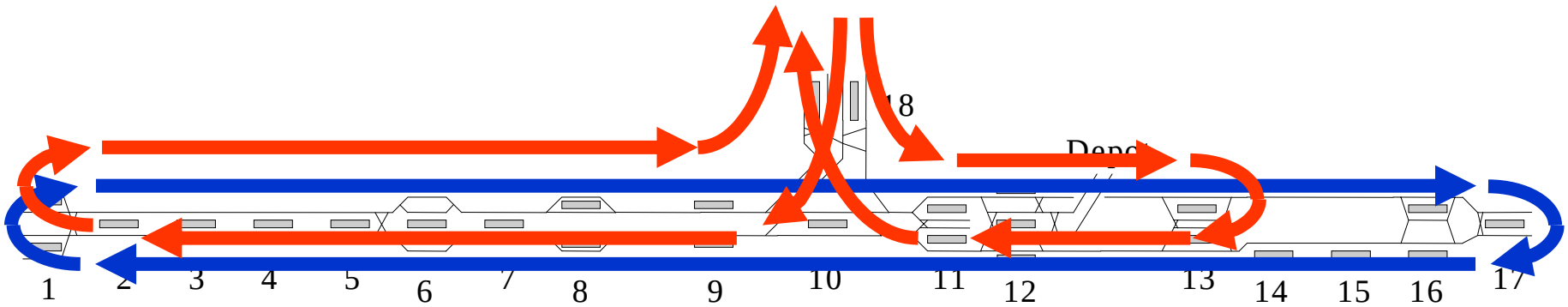
Allow trains to stop at non-platform location if it has no passenger

Generic priority level (GPL)

- To make a strategy (a list of policies), a concept of GPL can arrange the priority of levels
- GPL is defined for each requirement
  - GPL for the requirement of train-stop allowance can be written as follows:
    - ✓ Prohibit all trains from stopping at a non-platform location
    - ✓ Allow a train to stop at a non-platform location if it has no passenger
    - ✓ Allow a train to stop at any locations
- A strategy is derived from a combination of GPL for each requirement

Applying to an actual line



- An actual commuter line
- 40km
- 17 stations
- More than 500 trains (a day)
- Connecting to another commuter line

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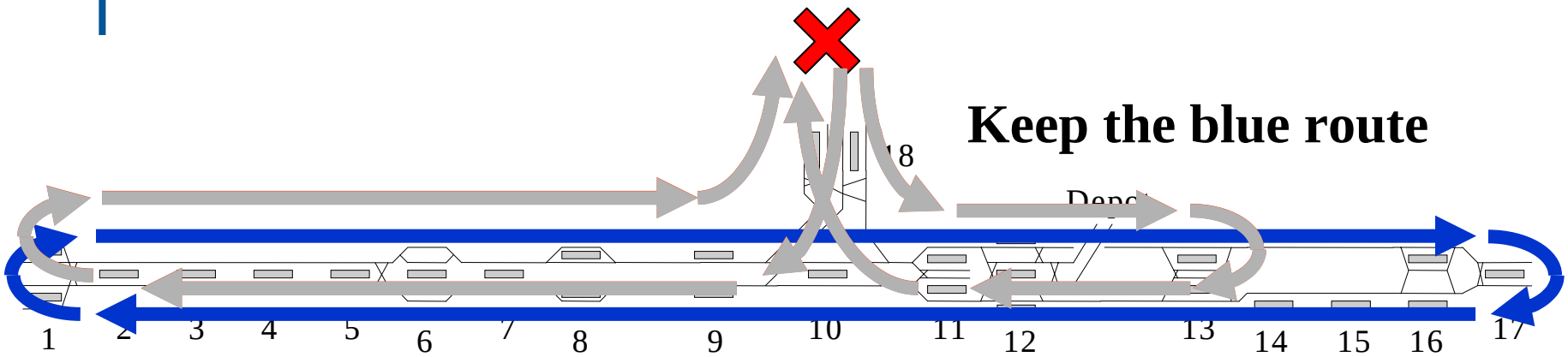

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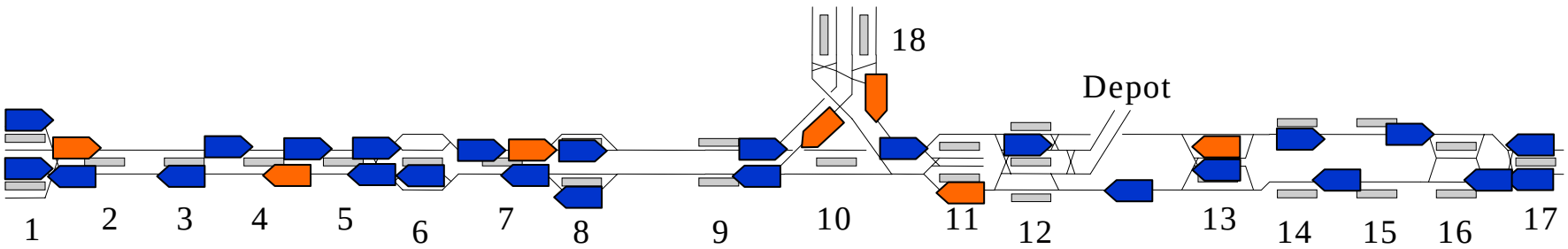

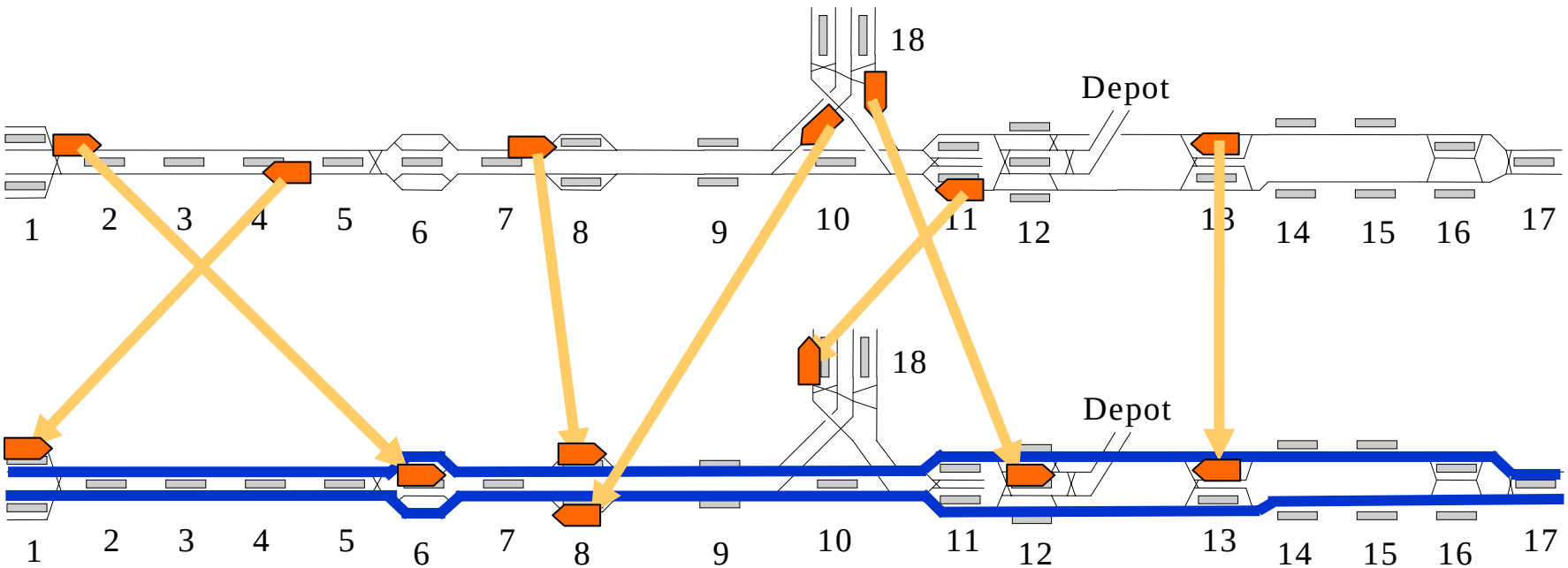

Conclusion

- We proposed a multi level approach to solve the train stop deployment planning problem using a basic algorithm and a list of strategic policies.
  - A concept of GPL
  - A concept of “a dummy track”
  - “Meta-iterative usage” of the approach can be available for a long train that can not stop at a regular-length platform
- At the next step, we are going to combine this algorithm and our train rescheduling algorithm