

# Passenger Path Plan Reliability Improvement Proposal

CHARLES UNIVERSITY PRAGUE

faculty of mathematics and physics



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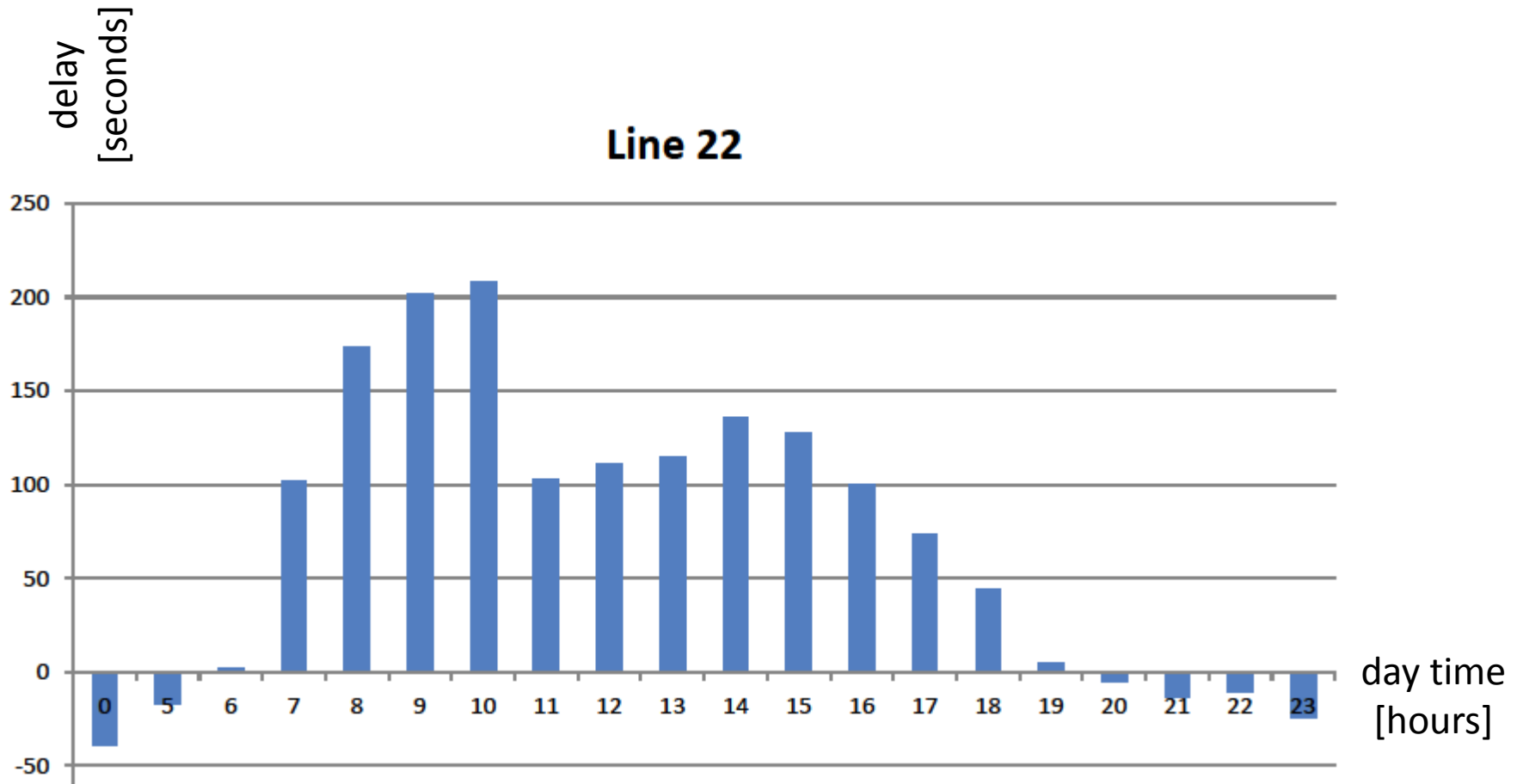
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# Situation

- Dense transportation network
  - large city environment
- Passengers using public transportation
  - need to reach the destination in time
- Different transportation means
  - sharing the transportation network
  - influencing each other
- Variable traffic situation
  - traffic conditions vary in time
  - influence to public transport services

# Time dependet delay



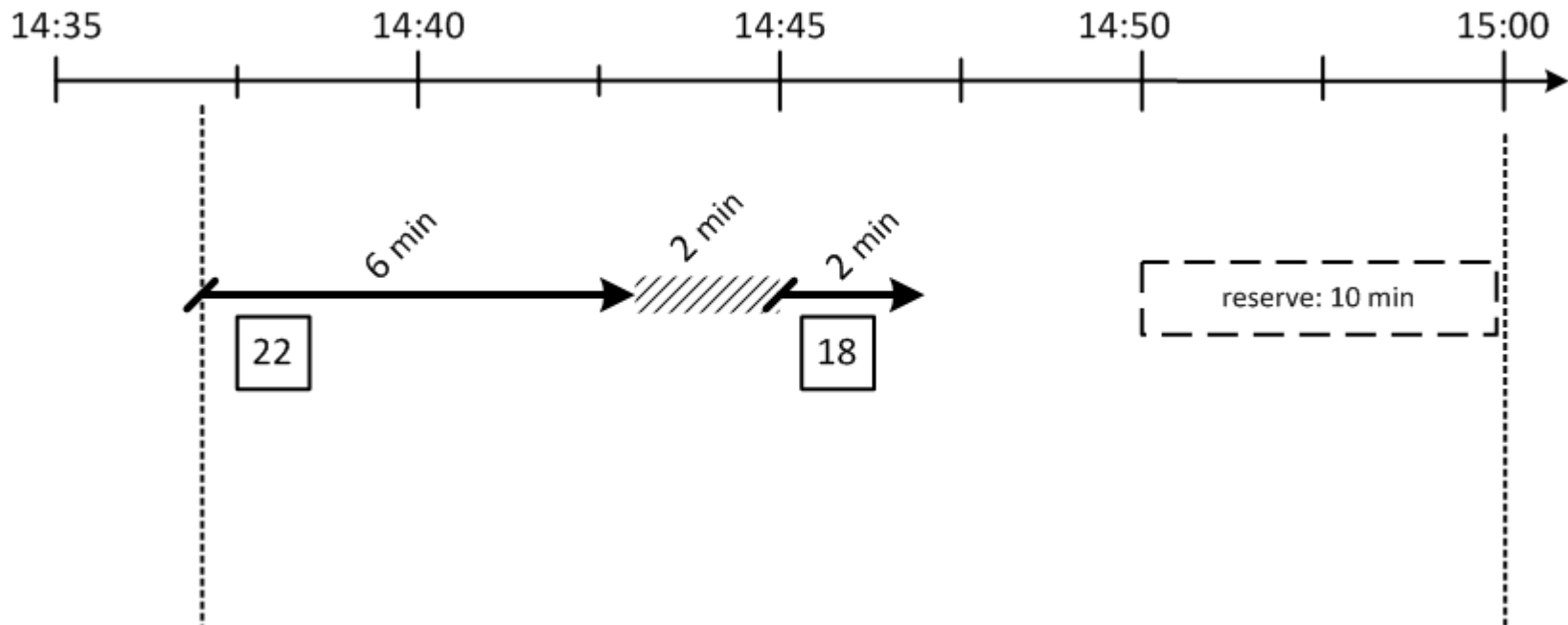
workdays in March 2008

# Motivation

- Reach destination in time
  - realistic travel plan
- Minimize travel time
  - unexpected waiting at the stop
  - rerouting failed connection plan
- Higher usability of path planning
  - passenger can prefer reliability
  - timeliness can't be without reliability

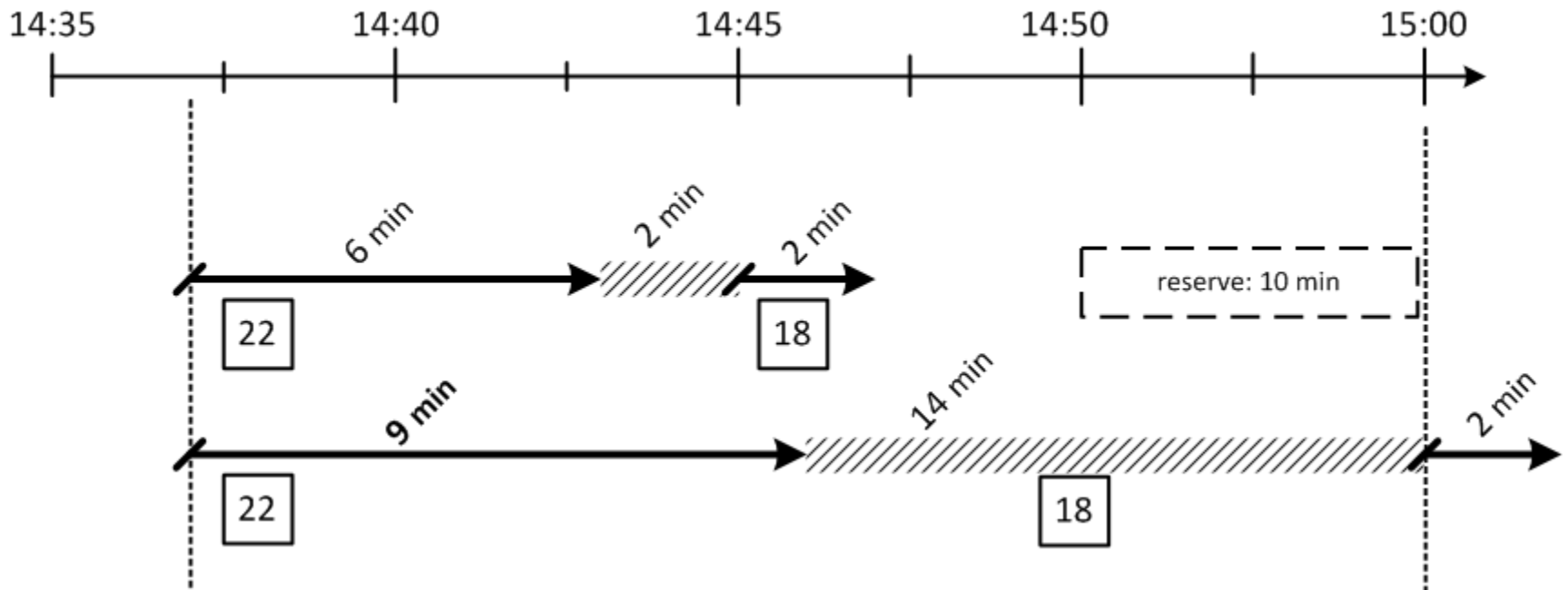
# Motivation – sample path plan

- Joe has a work meeting at 15:00
  - at least 10 minutes reserve



# Motivation – real situation

- Joe gets to a destination at 15:02
  - line 22 is often late → he will probably miss change to line 18
  - 10 minutes reserve is not sufficient



# Problem

- Connection plan with line changes
  - line change fail  $\approx$  path plan fail
- Line change
  - success depends on the timeliness of the source line
  - source line delayed & destination line in time  $\rightarrow$  possible failure

**Reliability of transfers made  
according to a timetable:**

of a carrier

**Line 20  $\rightarrow$  18**

86,91 %

**Line 12  $\rightarrow$  9**

78,27%

# Possible approaches

- Reserves
  - time reserve for the whole path
    - not corresponding to real needs
  - time reserve for every line change
    - too much time spend waiting
    - insufficient reserve in critical places
  - line change reserve
    - Ineffective in certain cases
- AVL data
  - actual delay → path plan correction
    - during travel
  - historical prediction
    - prediction accuracy and stability



# Delay prediction

- Historical AVL data
  - can determine lines that are often late
  - the values of average delay from history can be used to correct actual timetables
  - the future connections are planned according to corrected timetables

**Reliability of transfers made  
according to a timetable:**

	<b>Line 20 → 18</b>	<b>Line 12 → 9</b>
of a carrier	86,91 %	78,27%
predicted for days	89,33%	80,63%

# Refined prediction

- Day time based prediction
  - density of traffic may vary during a day
  - some types of transportation means can be influenced by actual traffic conditions
  - prediction calculated for every hour of a day separately would be more precise

<b>Reliability of transfers made according to a timetable:</b>	<b>Line 20 → 18</b>	<b>Line 12 → 9</b>
of a carrier	86,91 %	78,27%
predicted for days	89,33%	80,63%
predicted for hours	89,38%	87,59%

# Corollary

- Now we can
  - predict the delay according to a certain day time
  - predict whether the line change will be successful or not  $\approx$  the path plan will fail
- In the future we plan to
  - use a detailed information about the probability of arrival times to get the overall probability of successful line change
  - compute the overall reliability of proposed path plan
  - compare the path plans according to its reliabilities

# Conclusion

- Corrected timetables can increase reliability
  - minor – in general case
  - significant – in the case of change from line with higher average delay (critical point of usual path planning)
- Reasonable time consumption and reliability
  - time reserve can be placed in the path plan where it is highly probable it will be consumed
  - reasonable time buffers
  - based on long time experience with real traffic
- Path planner
  - calculates with more realistic path lengths
  - will choose better plan in a natural way

Thank you for your attention.

**THE END.**

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