Railway dispatching instance format

A railway dispatching instance is an XML file composed of 5 elements: *Network, Timetable, Snapshots, Objectives* and *RunningTimes.*

1. Network

The Network element describes the topology of the network (i.e. the physical railway infrastructure). Its child elements are basic types of railway infrastructure: *Stations, BlockPoints* and *Tracks.*

Stations

A facility where trains stop to load/unload passengers or freight.

Attributes

- Name. *The station's name*
- MainTrackId. *The id of the main track (i.e. station path with no switches)*
- StationId.

Child elements

- Internal Tracks. *Describes the length of the track, whether it has a platform and its id.*[1]

BlockPoints

An intermediate signal on open line tracks that represents the beginning of a new track block.

Attributes

- StationId. *The block's id*

Tracks

Rail connecting two stations.

Attributes

- TrackId. *Id of the track.*
- StationA. *Id of one of the adjacent stations.*
- StationB. *Id of the other station.*

2. Timetable

The official timetable (list of train schedules).

TrainSchedule

The ordered list of the train's scheduled activities

Attributes

- Length. *The train's length.*
- Destination. *Id of the final station in its timetable.*
- Origin. *Id of the first station in its timetable*
- Type. *The type of train (e.g. passenger, freight).*

[1] We assume that tracks can be accessed by all directions and tracks of arrival

- SpeedClass. *The train's speed class.*
- TrainId.

Child elements

- ScheduledStop. *One of the train's planned activity, describing the station's Id and the aimed times of arrival and departure (the latter a constraint on time of departure)*

3. Snapshots

Represents the state of the network at a given moment in time ("Now") with a list of TrainInfo elements.

TrainInfo

The status of the train at time "Now".

Attributes

- TrainId.
- Position. *The current position of the train. Possible values: Offline (if the train is not on the line), OnConnection (if the train is on an open line track) or InStation (if the train is a station).*
- StationId (optional). *If Position = InStation, states in which station.*
- TrackId (optional). *If Position = OnConnection, states on which track.*
- TimeIn (optional). *If Position = InStation or Position = OnConnection, represents the time at which the train entered the resource.*
- DelayInSeconds (optional). *If Position = InStation or Position = OnConnection, the delay with which the train entered the resource (in seconds)*

4. Objectives

A list of objective functions. Each objective function is the sum of delay penalty components for each train.[2]

DelayPenalty

The penalty a train incurs if its delay is within the given range.

Attributes

- StationId. *Station in which the penalty is applied.*
- FromSeconds. *Start of the delay interval for which this penalty is applied.*
- ToSeconds. *End of the delay interval for which this penalty is applied. If -1, the interval is unbounded.*
- FromValue. Value of the function's intercept at the beginning of the interval.
- Slope. Slope of the function in the interval.

[2] Only linear and piece-wise linear functions supported.

Example:

Assume train 1 is delayed 300 seconds (5 minutes) in station A, and the following are train 1's delay penalties.

<DelayPenalty StationId="**A**" Slope="**0.20**" FromValue="**0**" ToSeconds="**180**" FromSeconds="**0**"/>

<DelayPenalty StationId="**A**" Slope="**0.60**" FromValue="**36**" ToSeconds="**-1**" FromSeconds="**180**"/>

This implies that train 1 is delayed the full 180 seconds of the first interval, and an additional 2 minutes of the second (unbounded) interval.

A simple way to compute the cost is to identify the correct delay interval (in this case, the second) and interpolate using the initial o.f. intercept and the slope in the following way:

*Cost = (FromValue + Slope *(delay - FromSeconds) = 36 + 0.6*(300 – 180) = 108*

5. RunningTimes

List of running times associated with the open line tracks, grouped by train speed class. Elements identify the track and the associated minimum running time.