Extension of timetable compression approach for assessing the capacity of stations

– with turnarounds and alternative track assignment

Presentation of KAIN2

KAJT höstseminarium 2023

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Background

- UIC 406 - one of the most common ways to express capacity
- Trafikverket's method

Stations

- Stations with infinite capacity (!?)
- UIC 406 (2013) method for nodes/stations

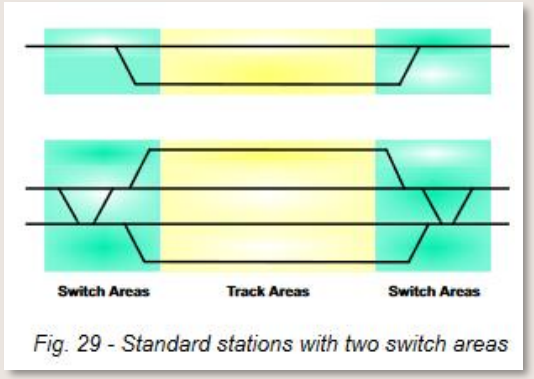
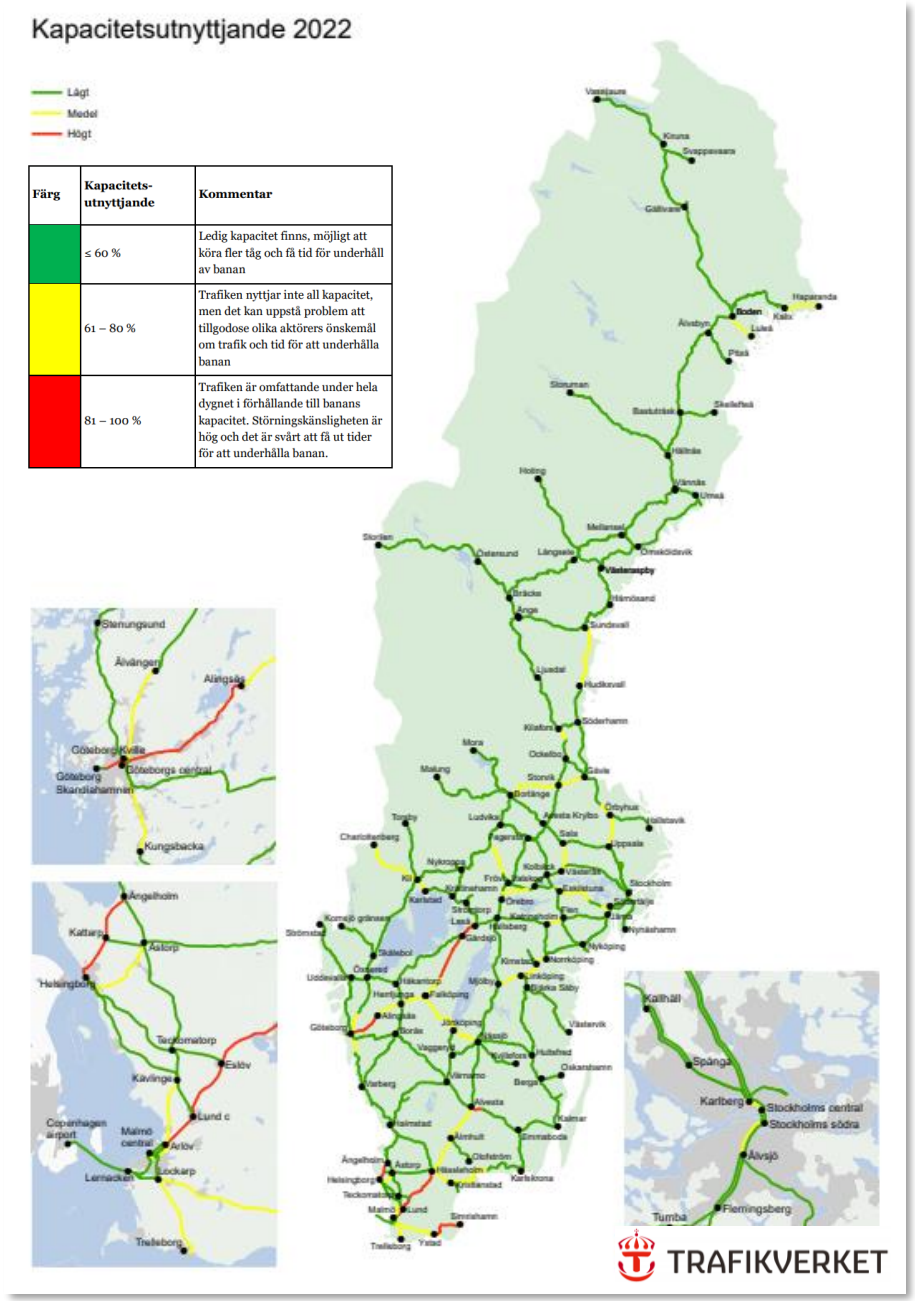


Fig. 29 - Standard stations with two switch areas



KAIN – Capacity in Networks (Kapacitet i Nätverk)

KAJT project 2017-2019

Participants:

- Jennifer Warg, PhD student KTH
- Ingrid Johansson, PhD student KTH
- Norman Weik, visiting PhD student Germany

Purpose:

- Improve the existing methods for estimation of capacity utilisation

Study:

- Compression of entire stations
  - Case study: Norrköping C
- Compression of lines
  - Longer lines segments
  - Allow for (some) overtakings
  - Case study: Södra stambanan (Hm-Av), double track

Background

- Weik, Warg & Johansson (2020) presented a method for station capacity calculations
- Based on UIC 406 compression, the station is treated in its entirety
- Infrastructure data and timetable information are retrieved from RailSys
- From the data block sections from each train route extracted and compared → find conflicts

KAIN2 project

Alternative track routes through stations.

Train turnarounds at stations.

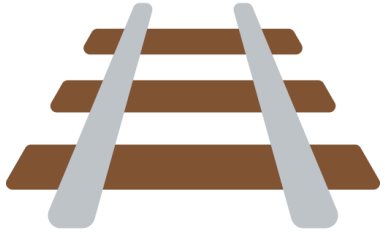
Implementation of single track with introduction of specifications such as ”samtidig infart”

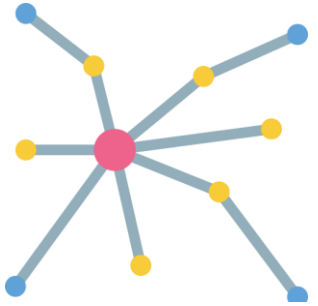
Comparing with Trafiverket’s current method based on UIC code 406.

Case study for both stations and lines in the entire Trafikverket owned railway network (with possible model calibration).

A method for grading the estimated capacity utilization is also developed.

A visualization/ illustration of the capacity utilization for lines and stations respectively





KAIN2

Aims

- More precise estimations
- Better predictability and punctuality

Existing infrastructure

- Analyse capacity utilization
- Find limitations in the network
- Better utilization of the existing infrastructure

Planning

- Effects of new infrastructure or timetable

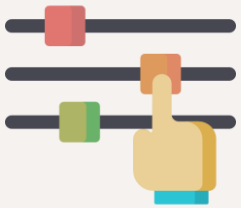
First part

- Connected turnarounds
- Alternative train routes at the station

First part

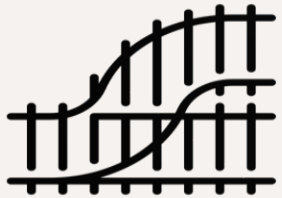
Task 1: learning

- Learn the model
- Calibration



Task 2: extensions

- Connect trains with turnarounds
- Assignment of alternative track routes

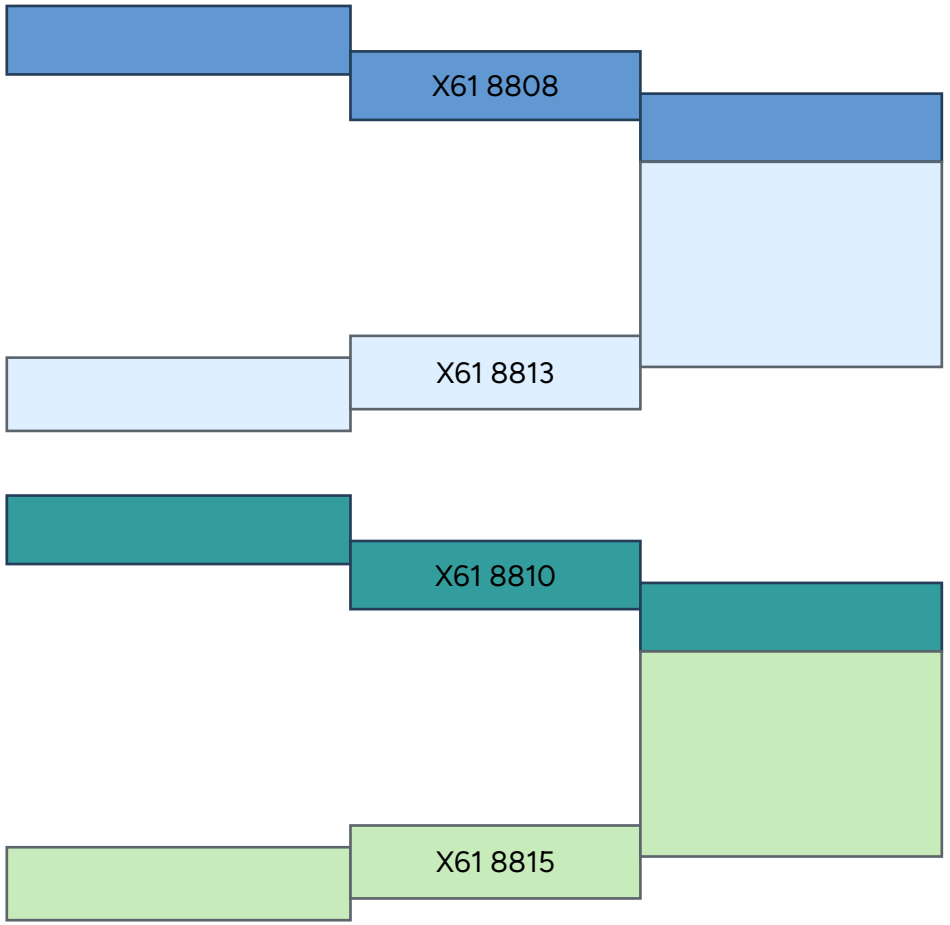


Case study

- Norrköping C
- Timetable T22
- Thur 27th of Oct 2022

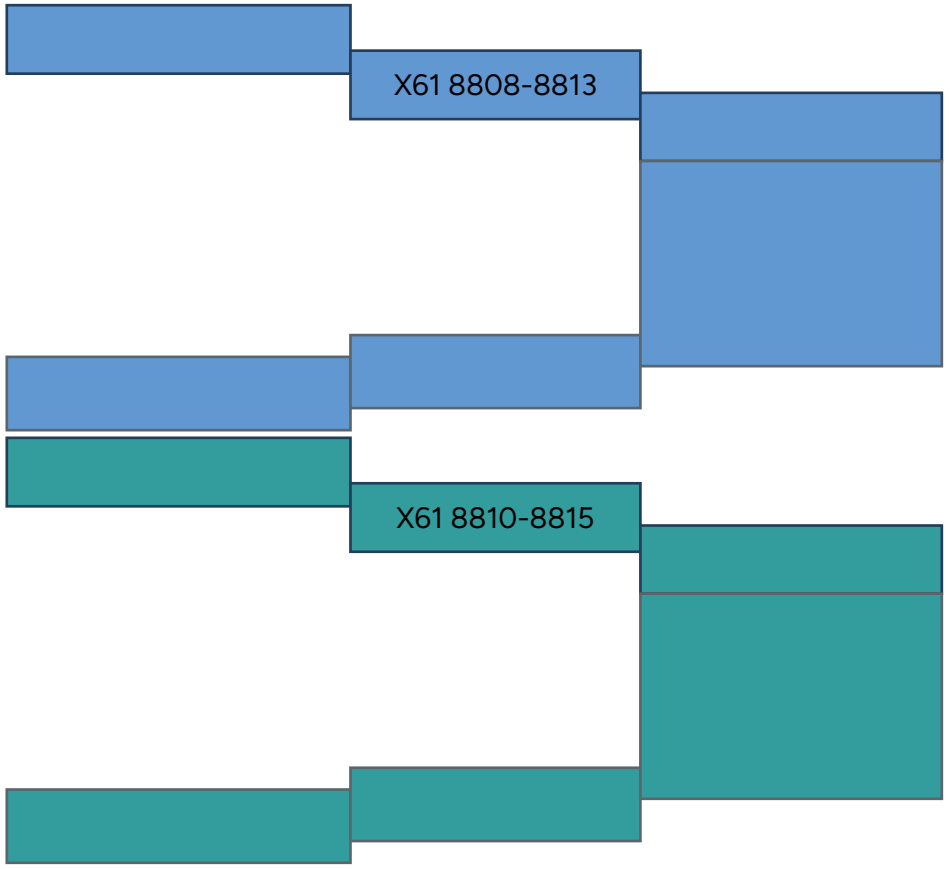
Extension 1: connected turnarounds

- Norrköping C is the end/start station for the commuter trains
- Each train treated individually
- Example: new composition of train order



Extension 1: connected turnarounds

- Norrköping C is the end/start station for the commuter trains
- Each train treated individually
- Example: new composition of train order
- Connected with new name



Extension 2: alternative tracks

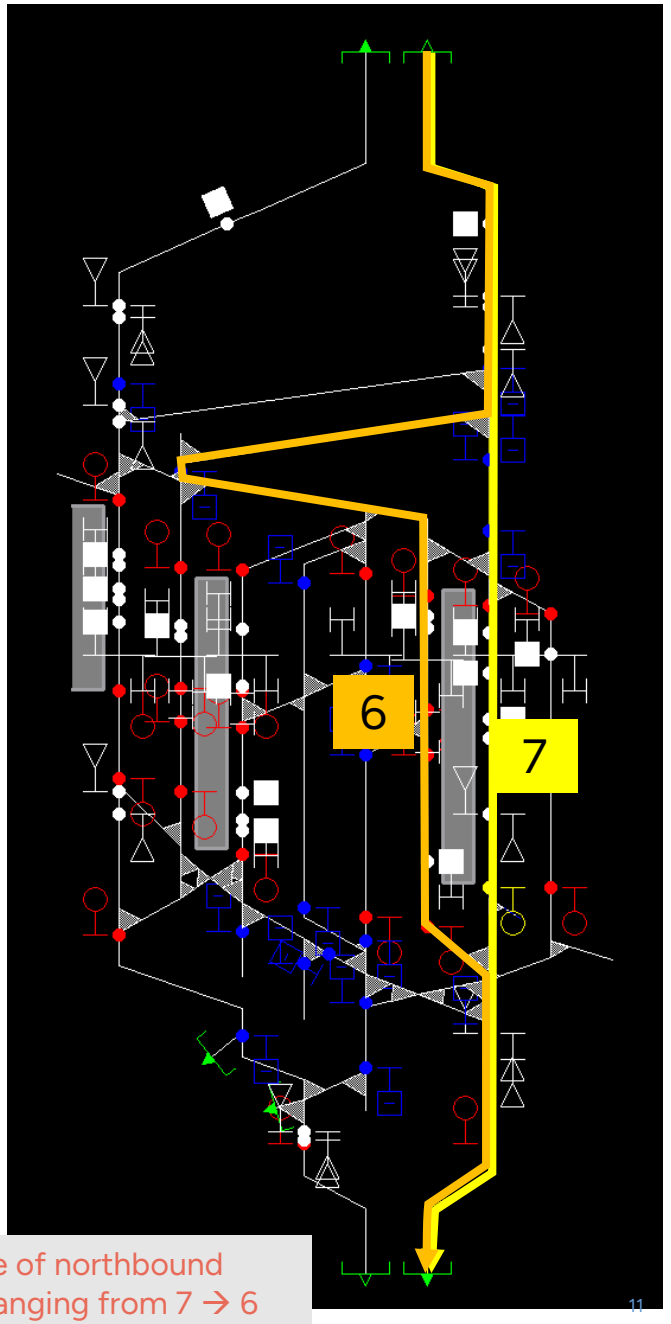
Method

1) Create a collection of templates of train routes

- Template
  - X2 (passing through)
  - X40 (passing through)
  - both directions
- Changing the track number
  e.g track 7 → track 6

2) Model evaluates, for each train

- Is there an alternative route available?
- If, compare both original route and alternative route for conflicts with previous trains
  → chooses the route with least conflicts



Example of northbound train changing from 7 → 6

Observations so far from the extensions

- The order of the trains seems to matter
- The model doesn’t really seem to know how to handle turning trains with long turning time, standing still at the platform waiting

Thoughts

1. How should we treat trains with long turning time?
   - Remove the stopping time, have a minimum turning time?
2. How much should we allow to re-order the trains?
3. How to define occupancy time at stations?

Future work

- Continue to validate and refine the model
- Apply another timetable and station

And next step

- Single lines
- Grading

Thank you

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