



Capacity for Rail

Simulation and models Demonstrator optimized timetabling

Dissemination 2, Brussels 3 November 2016



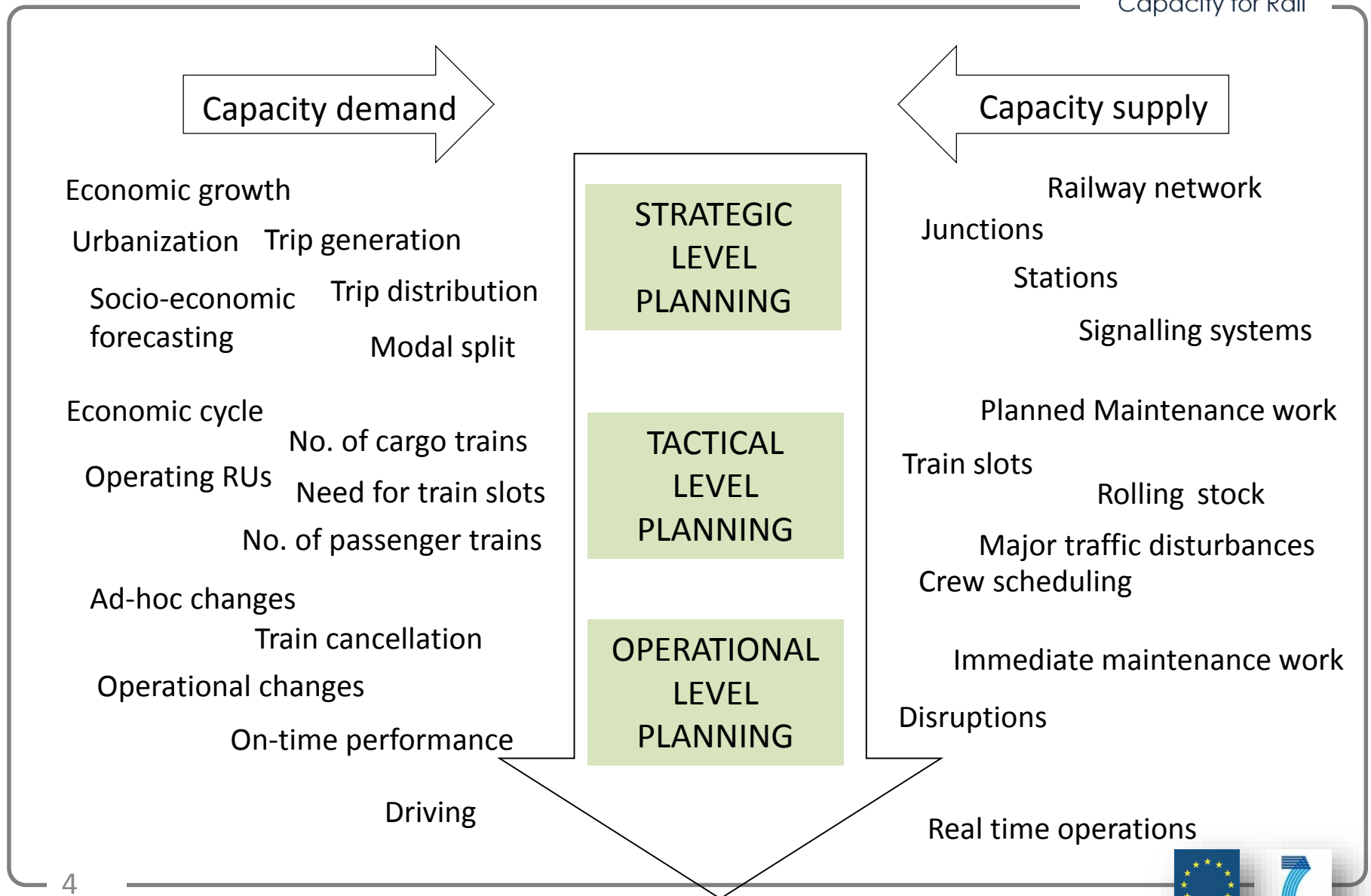
Magnus Wahlborg, Trafikverket,



- Scope
- Frameworks for modelling and simulations
- LiU model
- The Cain – LiU demonstrator
- CAIN/LiU life demonstration

Scope

Modelling railway capacity



First half

- state-of-art, models and processes, research Gap, scenarios, set up a framework

Second half Tasks 3.2.4, 3.2.5 and 3.2.6

- Enhancing frameworks for modelling and simulation
- LiU model optimisation
- Oltis IT system
- Demonstrator CAIN
- Scenario Malmö – Hallsberg
- Remaining work: Further study CAIN – LiU interaction and scenario Malmö - Hallsberg

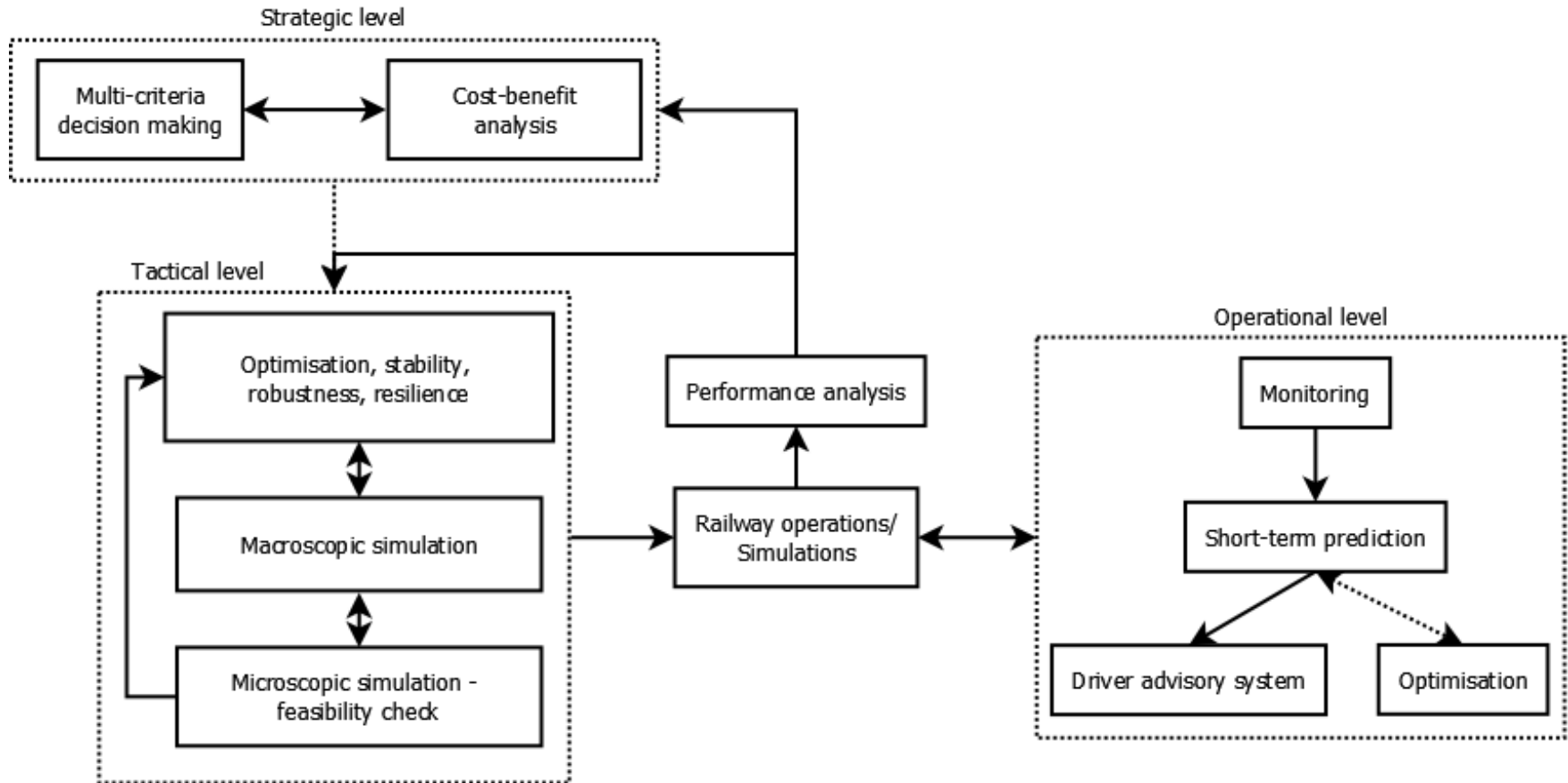
- Purpose:
Improve methods in tactical (timetable) planning and operational traffic => better capacity and improved punctuality/robustness
- Main partners
 - Infrastructure manager Trafikverket
 - System supplier Oltis – Traffic management systems
 - Research institute Linköping U - optimisation

Increased automation of tactical planning and operational process

- Ongoing trend tactical timetable planning process and operational traffic process is merging
- The limit between planning and operational traffic is 24 hours (8 hours)
- A third process is to carry out maintenance and monitoring (status of infrastructure and vehicles)

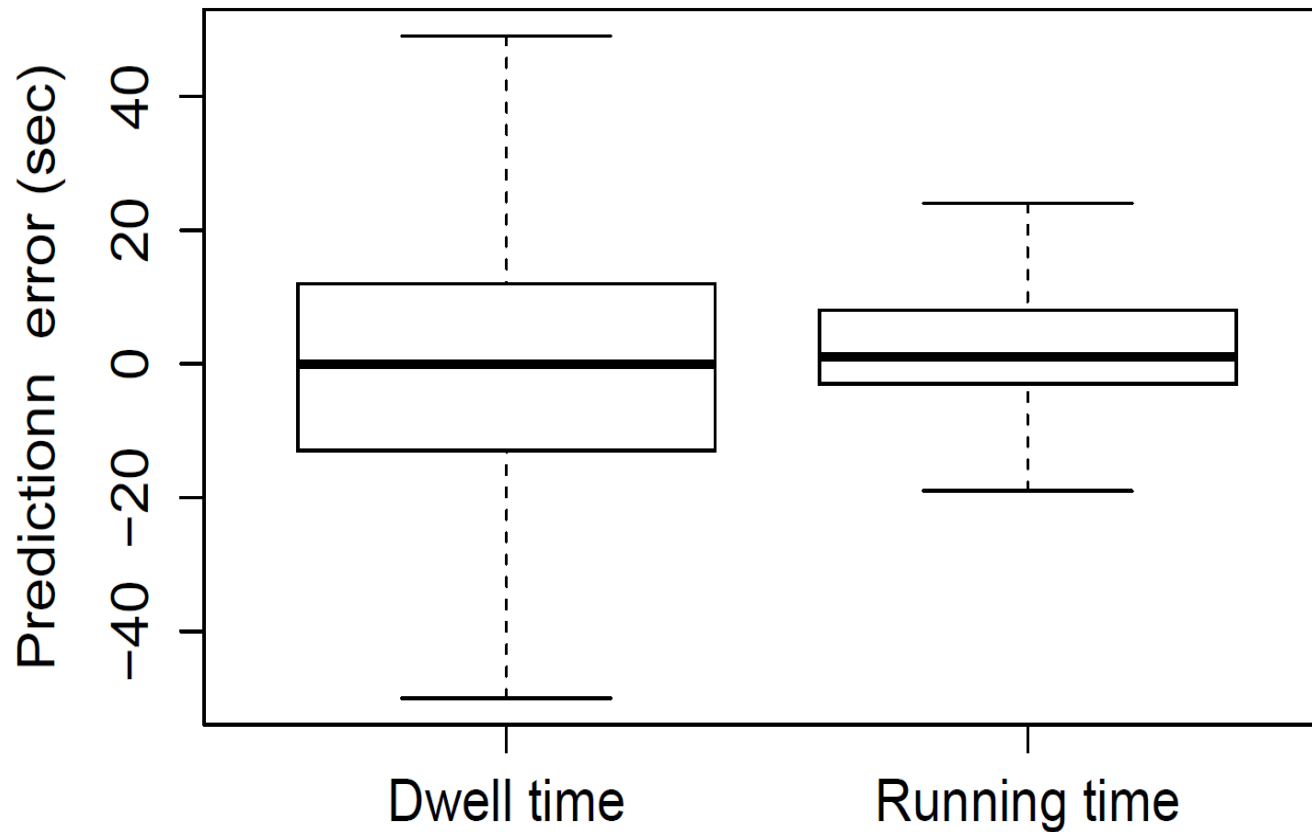
Frameworks for modelling and simulations

Modelling framework

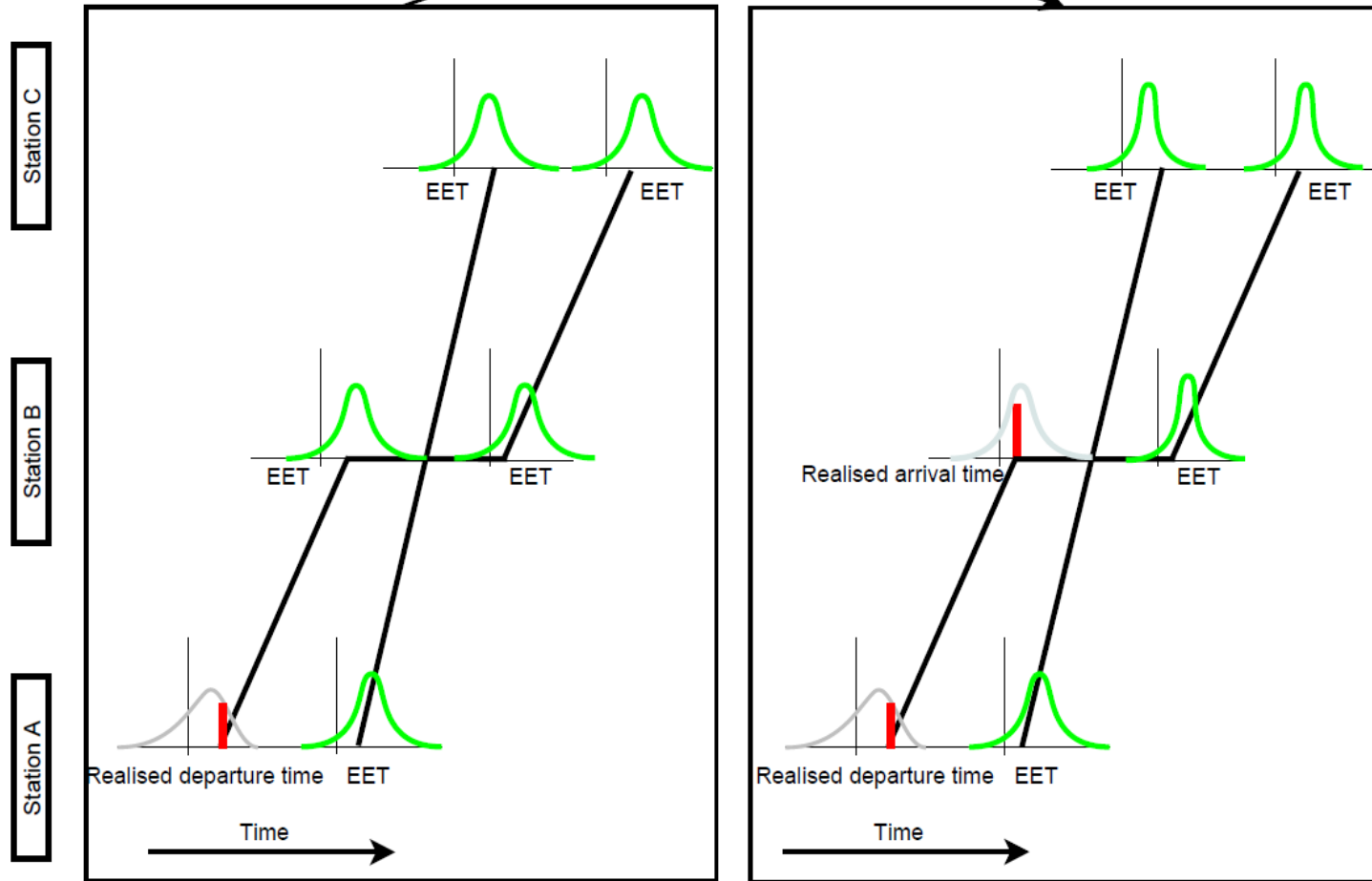


LiU model

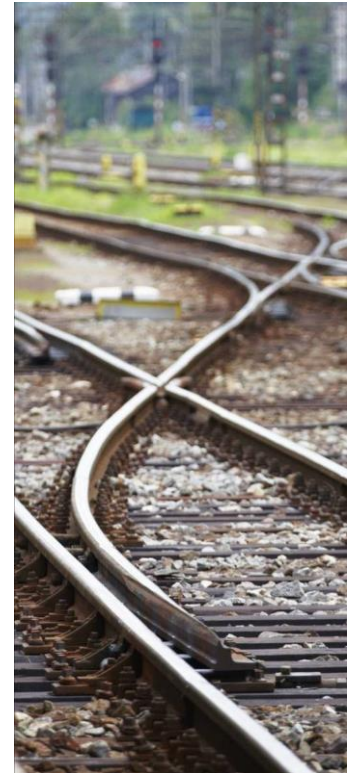
- Stochastic railway traffic model
- Data-driven model of traffic based on Bayesian networks (BN)
- Data driven model of traffic control actions based on Naïve Bayes classifier (NBC)
- Online use – uses real time information for dynamics of uncertainty and predicts traffic over long horizons
- Offline use – timetable simulation resulting in analysis of stability, robustness and resilience



Improved traffic control prediction of uncertainties

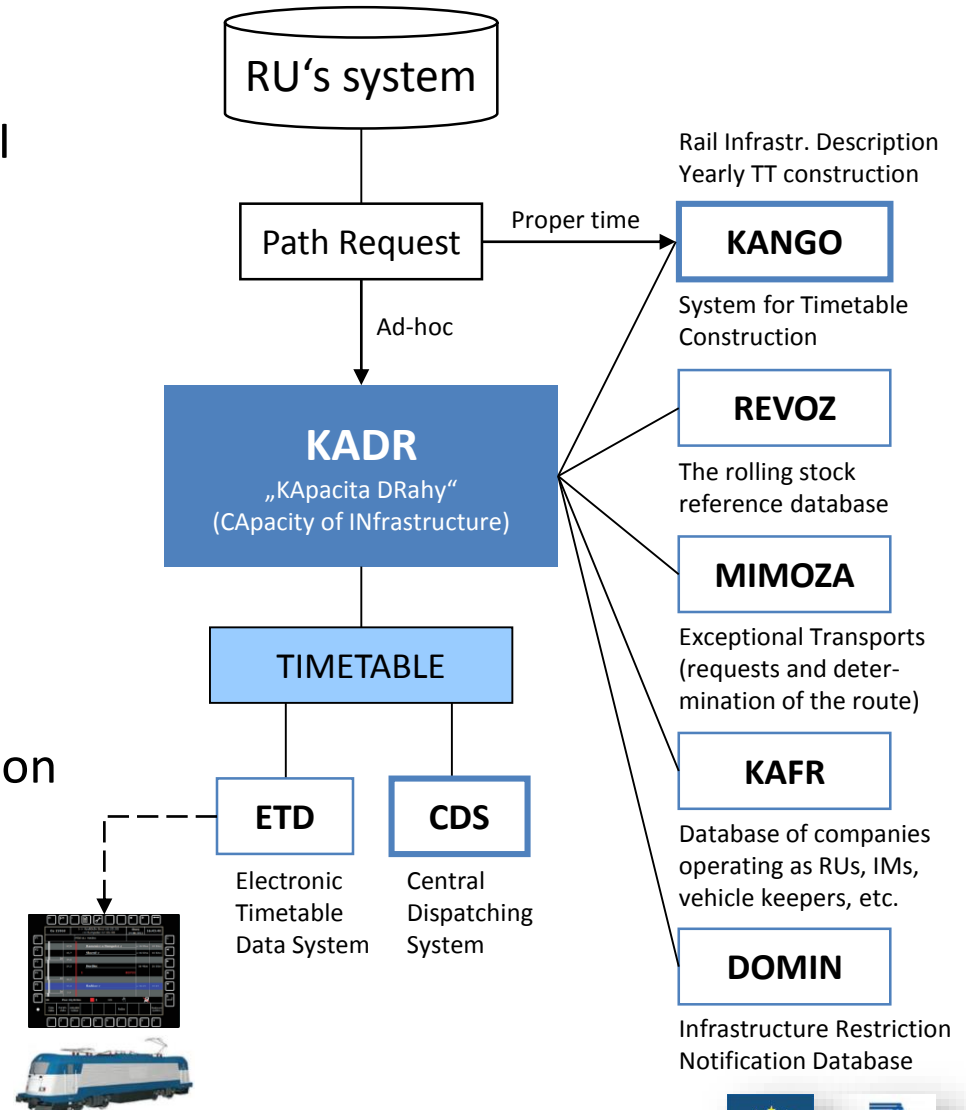


The CAIN - LiU: Demonstrator



Scheme of Oltis KADR and systems

- Request for path and capacity
- Support of communication in TSI TAF/TAP (ver. 5.3)
 - Path Request
 - Path Details
 - Path Cancelled
 - Receipt Confirmation
 - Error
 - Update Link
 - Path Section Notification
- Common Interface communication
- Timetable optimization
- Changes in timetables

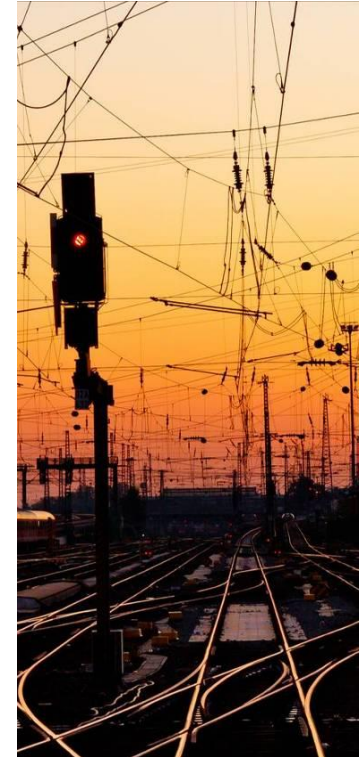


CAIN – *CA*capacity of the *IN*frastructure



CAIN – Demonstrator

- IT tool developed by OLTIS Group
- Based on KADR (CZ & SK infra-managers)
- Real time software for:
 - input of ad-hoc train paths into the real timetable
 - optimisation of the timetable
 - simulation of different scenarios
- CAIN interacts with the model from Linköping University



TRAFIKVERKET

oltis group

li.u LINKÖPING
UNIVERSITY

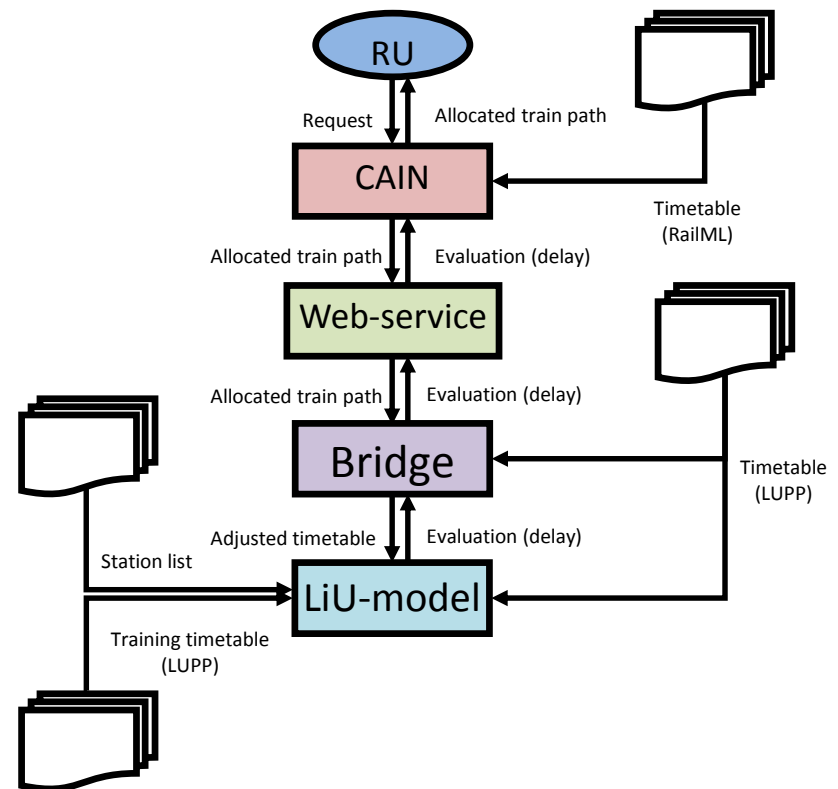
CAIN – part I

- **Import** static data of Sweden:
 - **Railway infrastructure**
 - **Timetable**
 - **Vehicles**
- **Corridor Malmö – Hallsberg**
- Data in RailSys/railML format
- **Process** the data
- **Create** a virtual network
- **Display** the railway network



The LiU model – Interaction with CAIN

1. A request for an new train path sends to CAIN. (blue)
2. CAIN creates an allocated train path. (red)
3. An application (Bridge) fetches the allocated train path from CAIN via an Web-service. (green)
4. The bridge inserts the allocated train path into an adjusted timetable. (purple)
5. The LiU-model evaluates the adjusted timetable. (teal)
6. The Bridge sends the evaluation back to CAIN via the web-service



CAIN / LiU model: Life demonstration

List of path requests: ready / for construction

CAIN Desktop

Application Marks Show Options Help

Requests

RU	Key number	Grouping	State	Proc.	Date of receiving	Capacity allocation	Rew.	All.	Prod.	Departure date	Path description	
SJ	098762-117-15/16a_2		K	T	12/13/2015	21	6		RJ	12/4/2016	Tranas - Boxholm	1
SJ	060412-117-15/16b		K	T	9/8/2016				N3	11/25/2016	Vikingstad - Giperberg	1
SJ	060407-117-15/16b_2		K	T	9/8/2016	9/8/2016	11	2	N3	11/18/2016	Vikingstad - Näsåjö C	1
SJ	060409-117-15/16b_2		K	T	9/8/2016	9/8/2016	11	2	N3	11/14/2016	Giperberg - Vikingstad	1
SJ	060371-117-15/16b_2		K	T	4/19/2016	9/8/2016	11	2	N3	11/14/2016	Mölby - Boxholm	1
SJ	060406-117-15/16b_2		K	T	9/8/2016	9/8/2016	11	2	N3	11/11/2016	Vikingstad - Giperberg	1
SJ	060408-117-15/16b_2		K	T	9/8/2016	9/9/2016	11	2	N3	11/9/2016	Giperberg - Näsåjö C	1
SJ	060411-117-15/16b_2		K	T	9/8/2016	9/12/2016	11	2	N3	11/9/2016	Vikingstad - Giperberg	1
SJ	060403-117-15/16b_2		K	T	9/7/2016	9/12/2016	11	2	N3	11/8/2016	Vikingstad - Giperberg	1
SJ	060405-117-15/16b_2		K	T	9/8/2016	9/8/2016	11	2	N3	11/8/2016	Vikingstad - Giperberg	1
SJ	060413-117-15/16b_2		K	T	9/8/2016	9/8/2016	11	2	N3	11/7/2016	Vikingstad - Giperberg	1
GC	060374-217-15/16b_2		K	T	4/19/2016	9/8/2016	11	2	N3	11/1/2016	Sandhem - Näsåjö C	30
SJ	060417-117-15/16b		K	T	9/13/2016				N3	11/1/2016	Näsåjö C - Sandhem	30
SJ	060397-117-15/16b		K	T	9/14/2016				TB	11/1/2016	Tranas - Fläby	30
SJ	060414-117-15/16b_2		K	T	9/8/2016	9/12/2016	11	2	N3	10/31/2016	Vikingstad - Giperberg	1
SJ	060410-117-15/16b_2		K	T	9/8/2016	9/8/2016	11	2	N3	10/19/2016	Tälle - Hallsberg pbg	1
SJ	060369-117-15/16b		K	T	4/19/2016				N3	10/18/2016	Vikingstad - Näsåjö C	1
GC	041518-217-15/16a		K	T	12/13/2015	30	2		RJ	10/14/2016	Östervärn - Älmhult	32
SJ	060402-117-15/16b_2		K	T	9/8/2016	9/8/2016	11	2	N3	10/11/2016	Tranas - Boxholm	1
SJ	060398-117-15/16b_2		K	T	9/2/2016	9/12/2016	12	2	N3	10/1/2016	Tälle - Hallsberg pbg	31
SJ	060399-117-15/16b_2		K	T	9/2/2016	9/9/2016	12	2	N3	10/1/2016	Kristianstad - Håsløholm	31
SJ	060426-117-15/16b		K	T	9/16/2016				N3	9/21/2016	Älmhult - Vetlanda	12
SJ	060411-117-15/16b_2		K	T	9/14/2016				N3	9/27/2016	Tranas - Näsåjö C	14

Number of displayed items: 1895 (23178)

Requests filter

Searching

Key number TR identification PR ID PA ID

Search

Filter

Capacity to be reviewed RU Green Cargo AB - 742174

Capacity to be reviewed was refused Selected period From date 9/ 2/2016 To date 12/15/2016

Partially reviewed Path point Sweden

Capacity allocated Processed by Not processed

Capacity cancelled Customer EC (ODn) - EuroCity

Capacity withdrawn Processing

Returned Traffic type

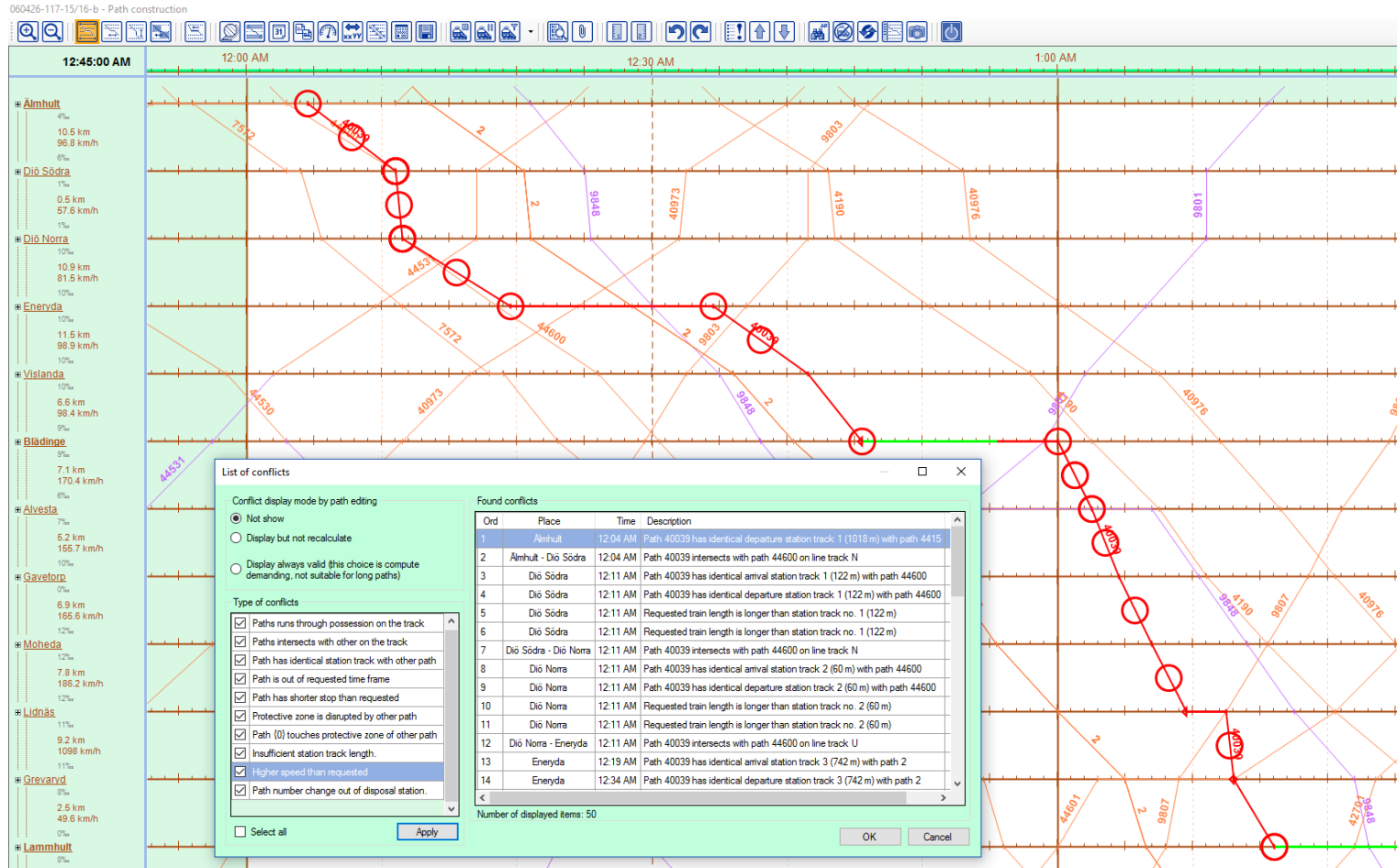
Basic paths (a)

Ad hoc paths - 3 working days and more (b)

Quick request display Requests filter

User Cain_4 (IM TRAFIKVERKET (Read and write)) | 66,116 kB (6,188) | 00:00:13 | Distant processing

Construction detail and possible conflicts:



Calculation of traffic impact:

Capacity reviewing ×

Found exceptions

Ignore	Exception description	Place
<input type="checkbox"/>	In some traffic point there is stop shorter than requested	(20) Nässjö C
<input type="checkbox"/>	"All exception of type ""In some traffic point there is stop shorter than requested"""	

Calendar

	Mo	Tu	We	Th	Fr	Sa	Su	Mo	Tu	We	Th	Fr	Sa	Su	Mo	Tu	We	Th	Fr	Sa	Su	Mo	Tu	We	Th	Fr	Sa	Su	Mo	Tu						
September '16				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30			
October '16						1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
November '16		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30					
December '16				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31		

Instant capacity path

Approval number of neighbouring IM

Request remark

Remark of IM

Request reason

Recommendation Close path offer

Result of capacity review Close path offer and immediate review

Forwarded on

Forwarded by

Calculation of traffic impact

Average delay on network

The result of the traffic impact (the value = 3):

Capacity reviewing ×

Found exceptions

Ignore	Exception description	Place
<input checked="" type="checkbox"/>	In some traffic point there is stop shorter than requested	(20) Nässjö C
<input checked="" type="checkbox"/>	"All exception of type ""In some traffic point there is stop shorter than requested"""	

Calendar

	Mo	Tu	We	Th	Fr	Sa	Su	Mo	Tu	We	Th	Fr	Sa	Su	Mo	Tu	We	Th	Fr	Sa	Su	Mo	Tu	We	Th	Fr	Sa	Su	Mo	Tu						
September '16				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30			
October '16						1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
November '16		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30					
December '16				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31		

Instant capacity path

Approval number of neighbouring IM

Request remark

Remark of IM

Request reason

Recommendation Close path offer

Result of capacity review Close path offer and immediate review

Forwarded on

Forwarded by

Calculation of traffic impact

Average delay on network

Allocation the train number:

Capacity reviewing ×

Found exceptions

Ignore	Exception description	Place
<input checked="" type="checkbox"/>	In some traffic point there is stop shorter than requested	(20) Nässjö C
<input checked="" type="checkbox"/>	"All exception of type ""In some traffic point there is stop shorter than requested"""	

Calendar

	Mo	Tu	We	Th	Fr	Sa	Su	Mo	Tu	We	Th	Fr	Sa	Su	Mo	Tu	We	Th	Fr	Sa	Su	Mo	Tu														
September '16				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30				
October '16						1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	
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December '16			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31				

Inquiry ×

Do you really want to close the path offer and review the capacity?

Recommendation: 11 - draft of path is possible
 Result of capacity review: 12 - draft of path is possible with time shift

Forwarded on: 9/16/2016 3:34:03 PM
 Forwarded by: Cain 3

Calculation of traffic impact
 Average delay on network: 3

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WP3.2

Trafikverket

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