

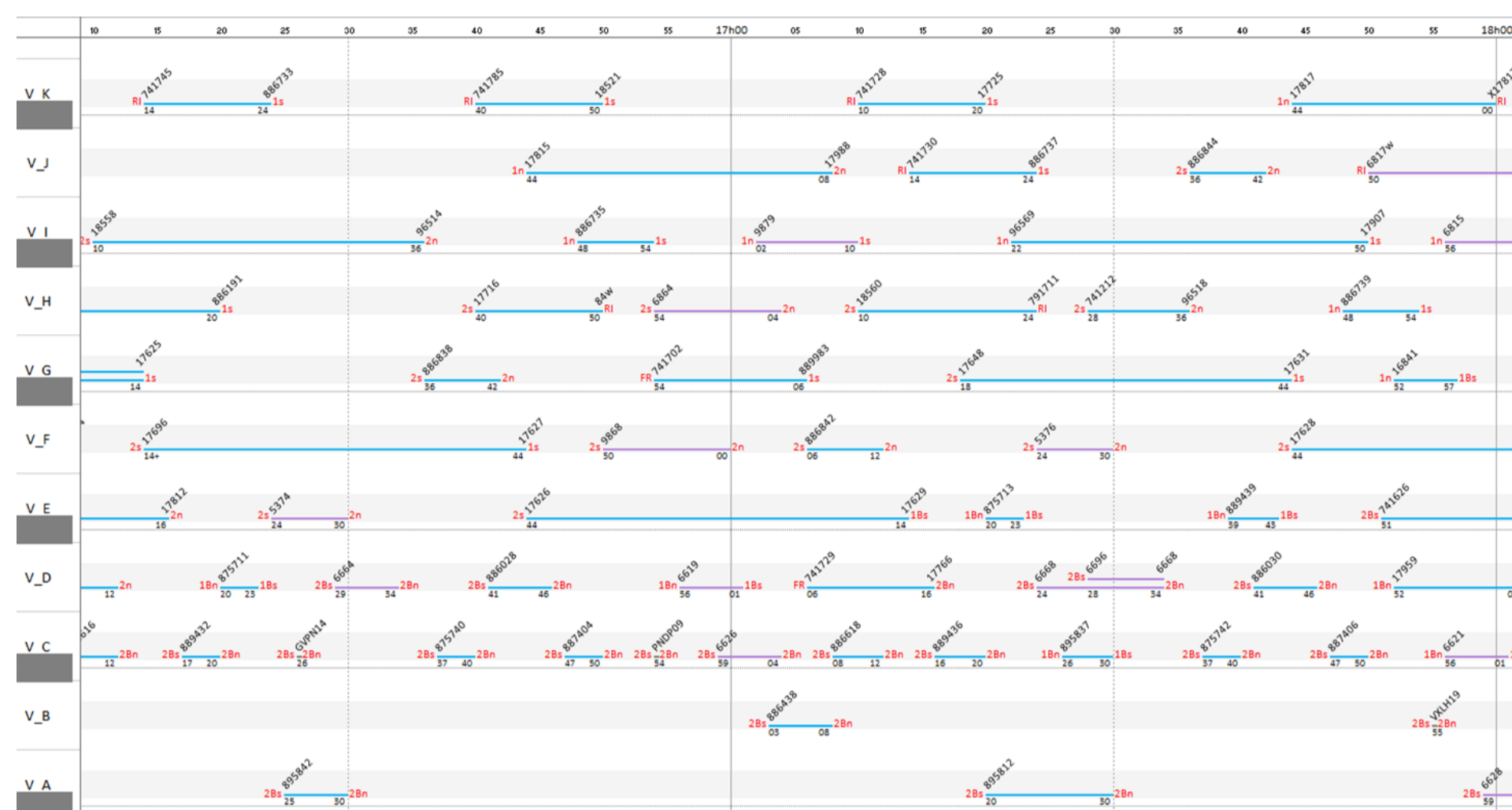
A COOPERATIVE MODEL OF MACHINE LEARNING AND OPERATIONS RESEARCH FOR RAILWAY OPERATIONS

Milliet de Faverges Marie
SNCF Réseau – Direction des Projets Franciliens

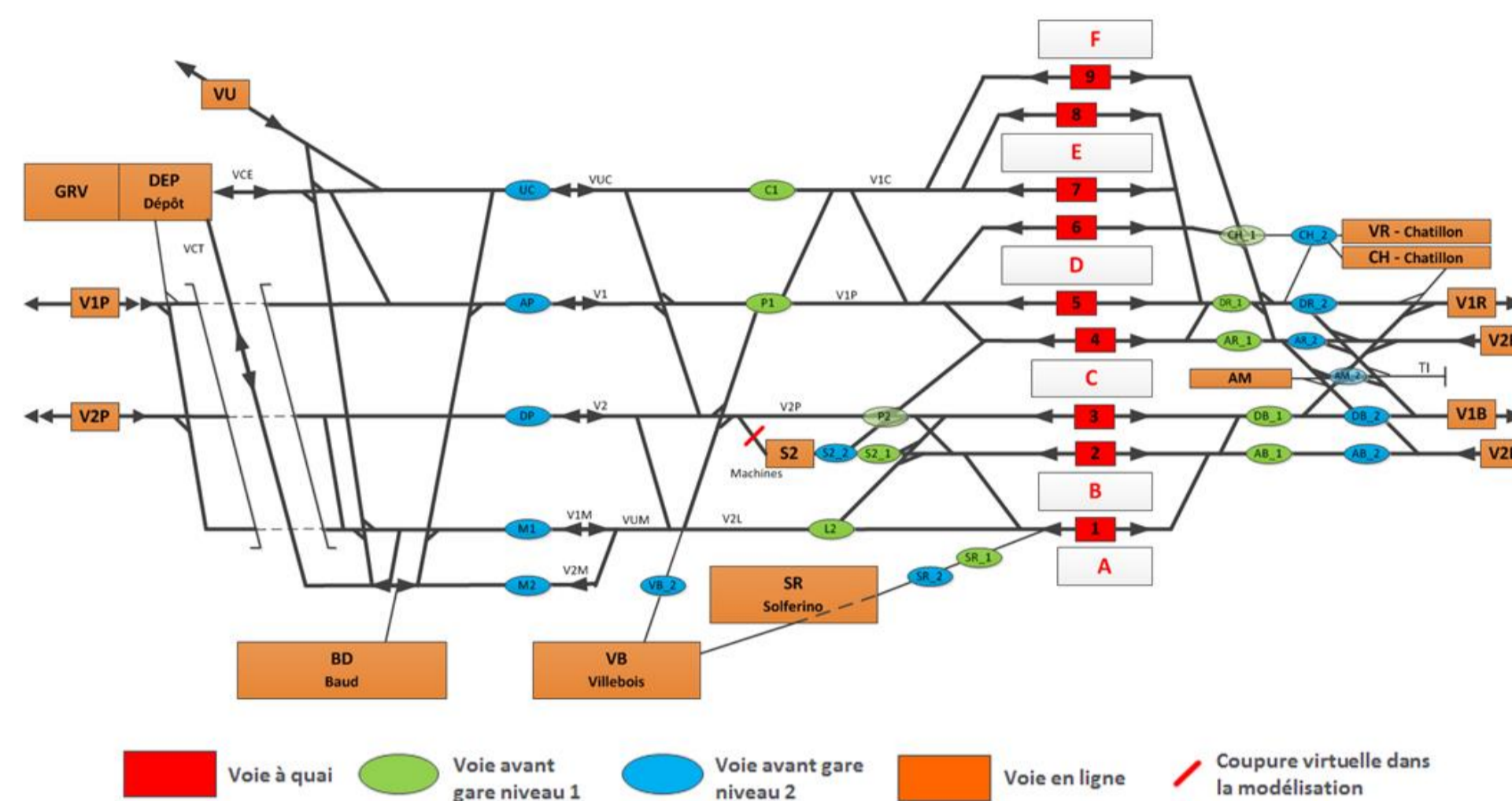
Supervisors :
Boubekeur Merabet
Bertrand Houzel
Thesis Directors :
Christophe Picouleau
Giorgio Russolillo
Laboratory: CEDRIC - CNAM
Started in February 2017

The platforming problem

✓ Platforms occupations



✓ Routing trains through stations



✓ Complexity

#Trains	400
×	×
# platforms	28
×	×
# arrival paths	107
×	×
# departure paths	127

150 000 000 possibilities

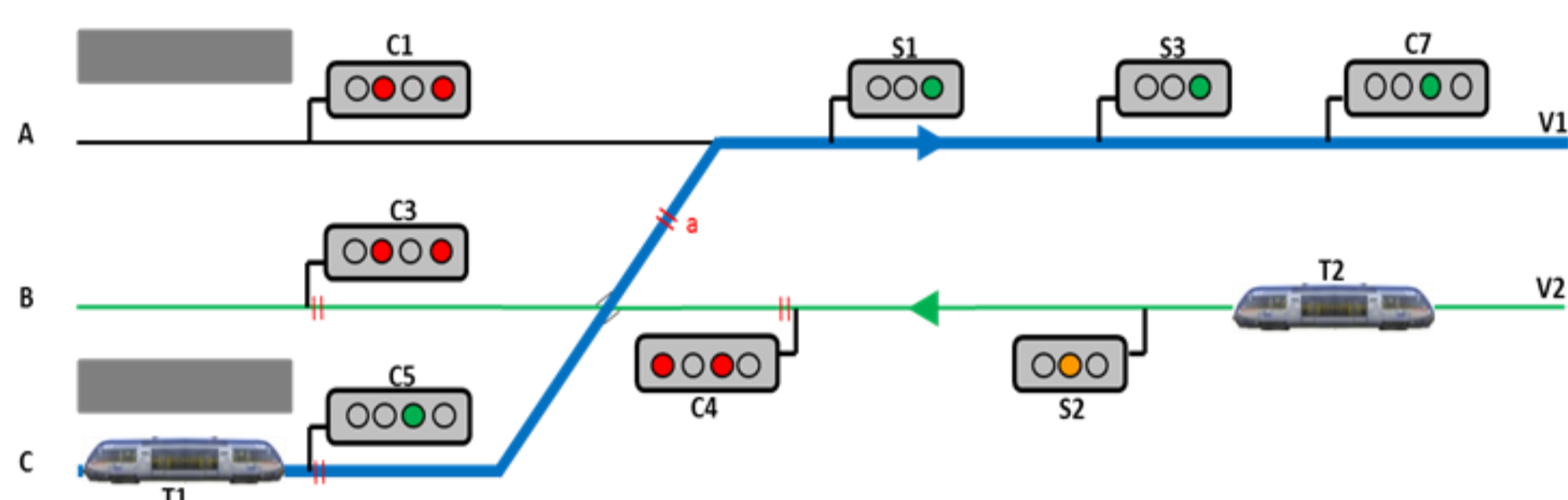
Resolutions

Objectives

- ✓ Feasibility
- ✓ Preferences
- ✓ Robustness

Constraints

- ✓ Security
- ✓ Infrastructure
- ✓ Passenger perspective



Approach

- ✓ Definition of incompatible paths affectations for simultaneous trains
- ✓ Buffer time allocation
- ✓ Mixed Integer Linear Programming Formulation

Limits

- ✓ Determinist scheduling
- ✓ Sensitive to delays and perturbations
- ✓ Need rescheduling in real time operations

ML perspective

- ✓ Data available : historic, weather data, speed limitations, holidays, ...
- ✓ Add of stochasticity in the OR model
- ✓ Better understanding of the perturbations
- ✓ Improve robustness with conflicts anticipation
- ✓ Adaptive setting of preferences and buffer times

Delay Prediction

- ✓ Data : all records between 01/07/2016 and 30/04/2017 for high speed trains in commercial service arriving at Montparnasse station (Paris) : 23 000 trains
- ✓ We want to obtain realistic probability estimation for small delays
- ✓ Gamma or Weibull distributions fit if we consider only the positive delays
- ✓ Test for Generalized Linear Models with the R package gamlss

