

OpenTrack simulation for suburban tunnel in Paris (RER B & D)

Presentation
Opentrack – Viriato workshop
January 24th, 2008
Zurich, Switzerland



Table of contents

17/09/07 January 24th, 2008

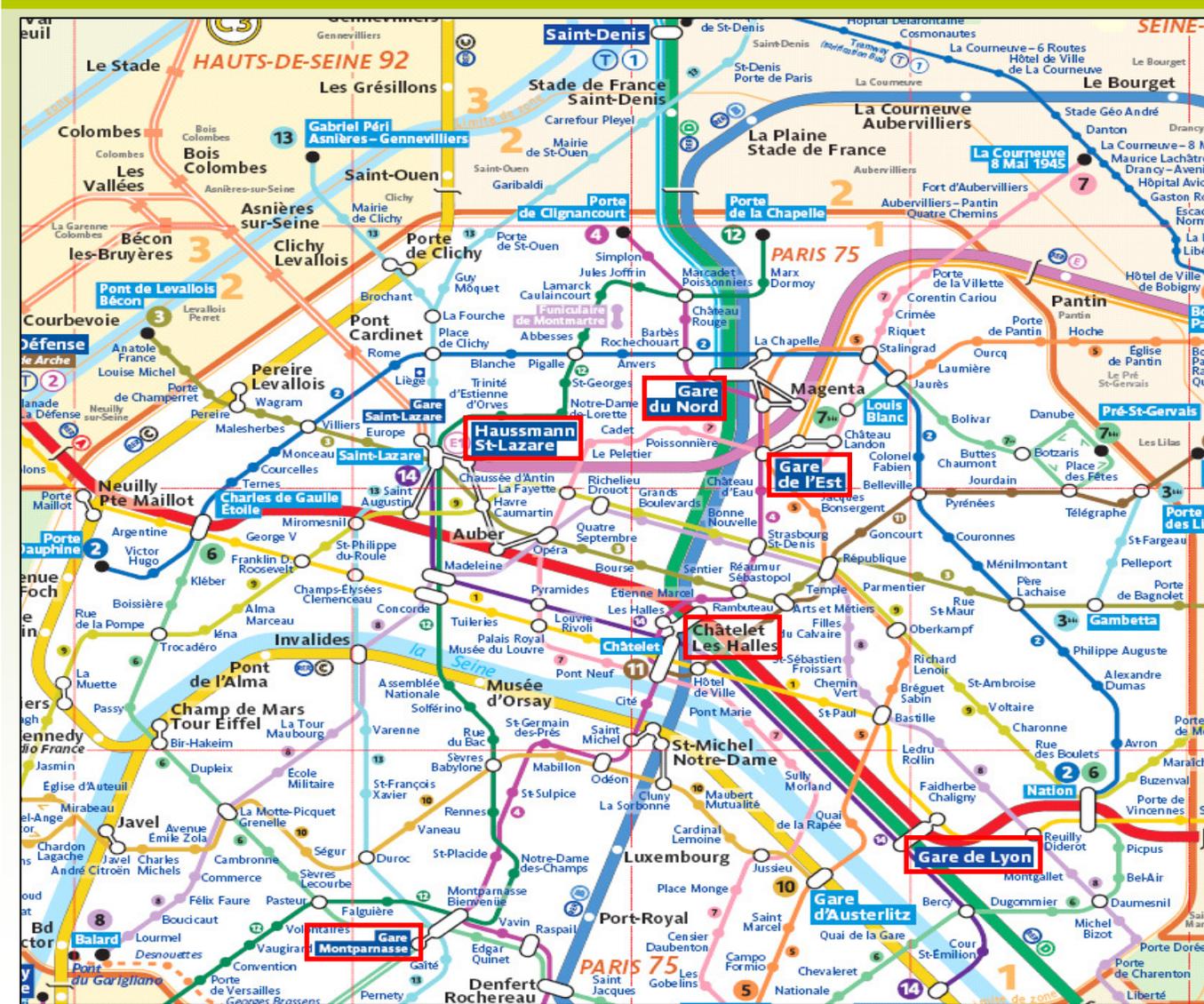


- ▶ **Introduction**
- ▶ **Overall context**
- ▶ **Main technical data**
- ▶ **Major stakes**
- ▶ **Before simulating : our method**
- ▶ **Simulation in several steps**
- ▶ **Interesting scenarios**
- ▶ **Conclusion**



1. Introduction : Dense transport network

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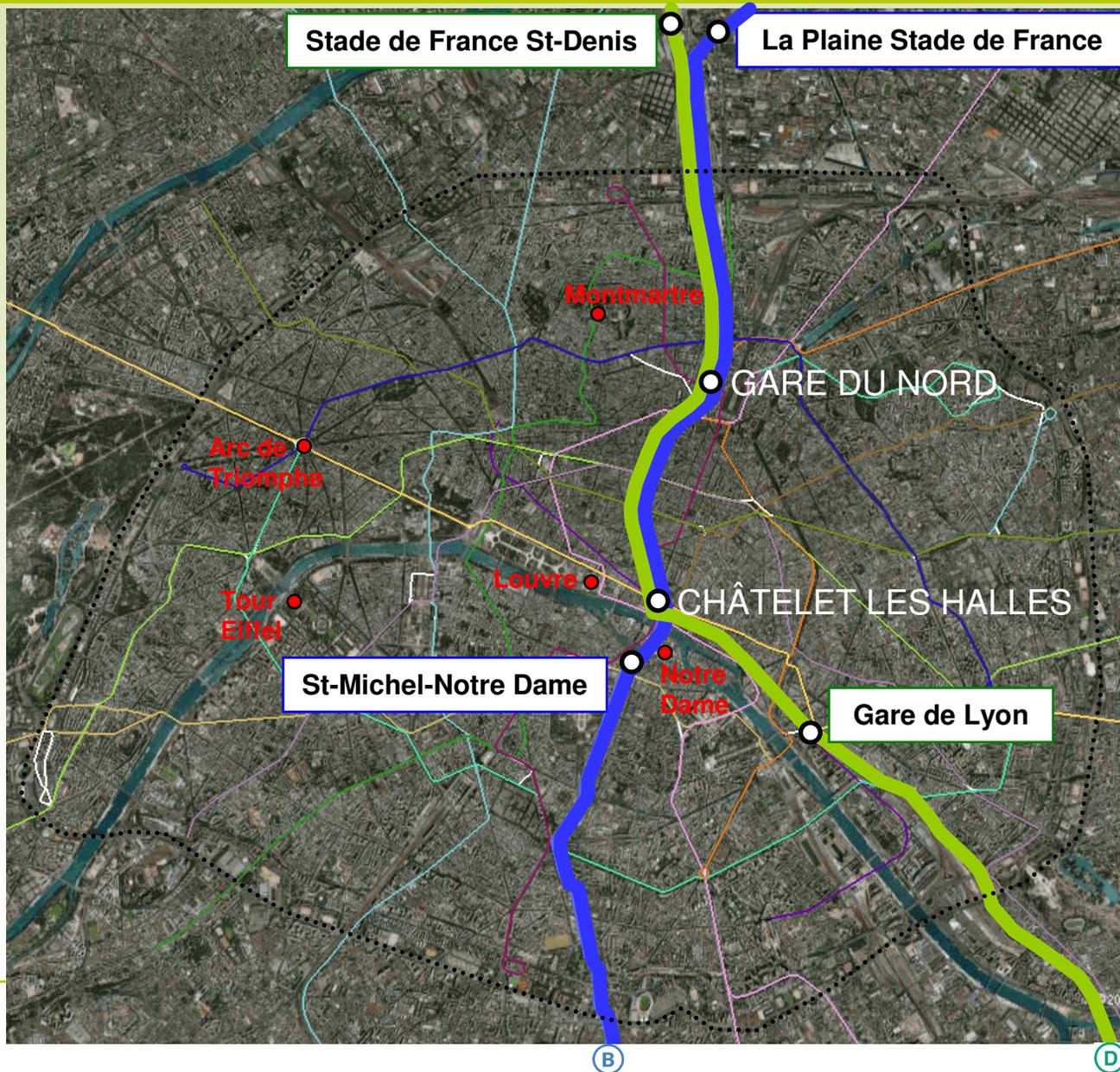
Inside Paris

- **Underground :**
16 lines (1 automated),
211 km, 300 stations
- **Regional trains crossing the city :**
5 lines, 31 stations



1. Introduction : Project location

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Gare du Nord +
Châtelet les Halles :
2 major nodes in
the Paris transport
network



3

2. Overall context

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- ☞ Operating problem :
 - ☞ Convergence of 2 overcrowded lines on the same double track tunnel
 - ☞ Regularity and customer satisfaction declining
 - ☞ Choices to be made by the Transport Authority to improve fluidity

☞ Client : Syndicat des Transports d'Ile de France (STIF)

- ☞ Transport authority of Ile de France region



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- ☞ RATP (Paris region transport company) → southern part of line B
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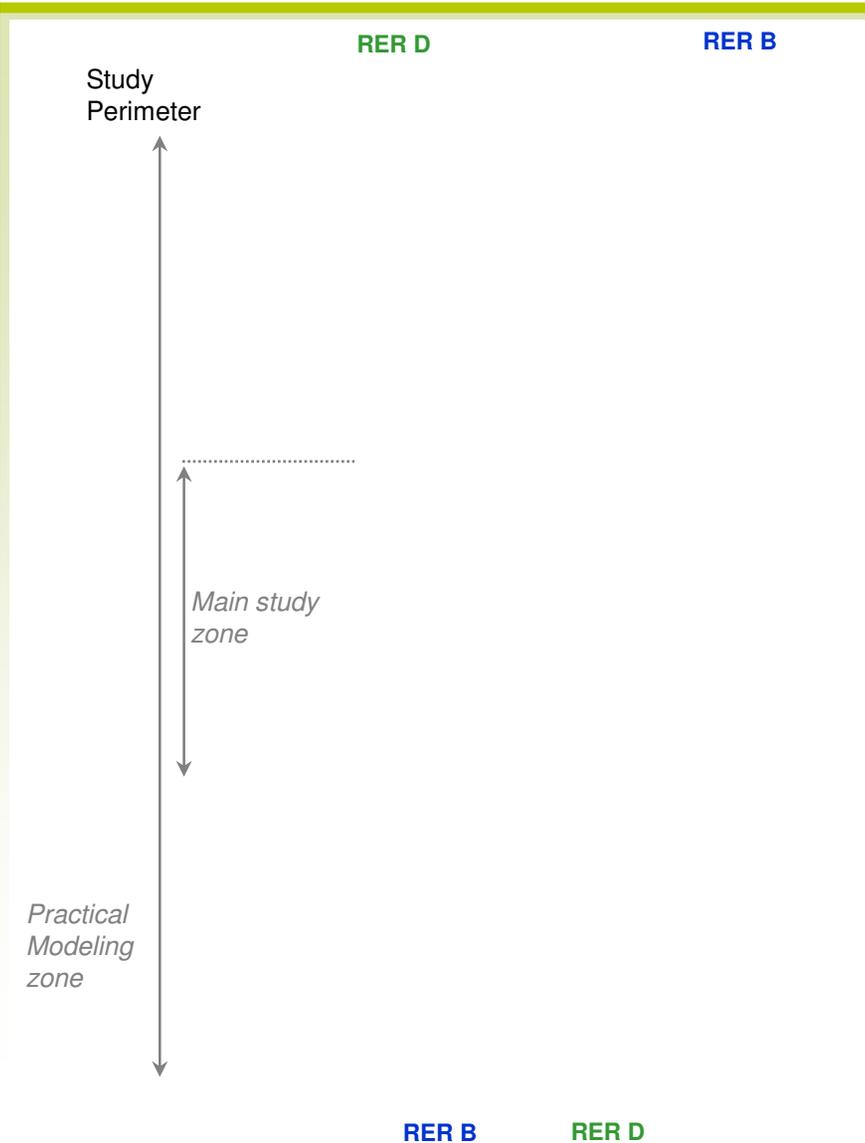
☞ Support : Mr Huerlimann – OpenTrack GmbH

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3. Main technical data

17/09/07 January 24th, 2008



- ☞ Timetable : 32 trains per hour per direction = 20 trains line B + 12 trains line D
- ☞ Headway : 90 secondes, theoretical headway < 90 sec
- ☞ Two controlling stations (RATP & SNCF)
- ☞ Two types of rolling stock
- ☞ Two electrical power supply systems (change at Gare du Nord)
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- ☞ Use of an « extra track » in Châtelet station, called « voie Z » by line D.

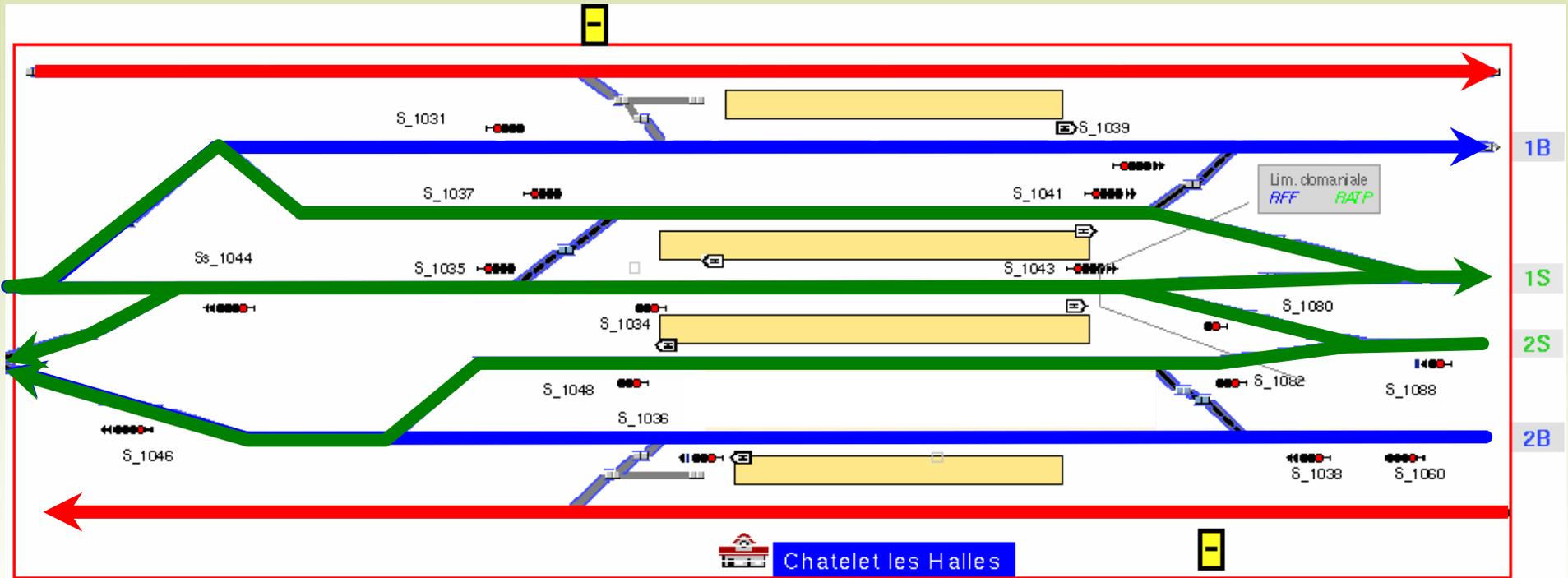


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Focus on station : Châtelet-les-Halles



(north) La Plaine Stade de France ⇐



⇒ St Michel Notre Dame (south)

(north) Stade de France – St Denis ⇐



⇒ Paris Gare de Lyon (south)



Not simulated

Dedicated tracks in the station – No interactions with lines B & D

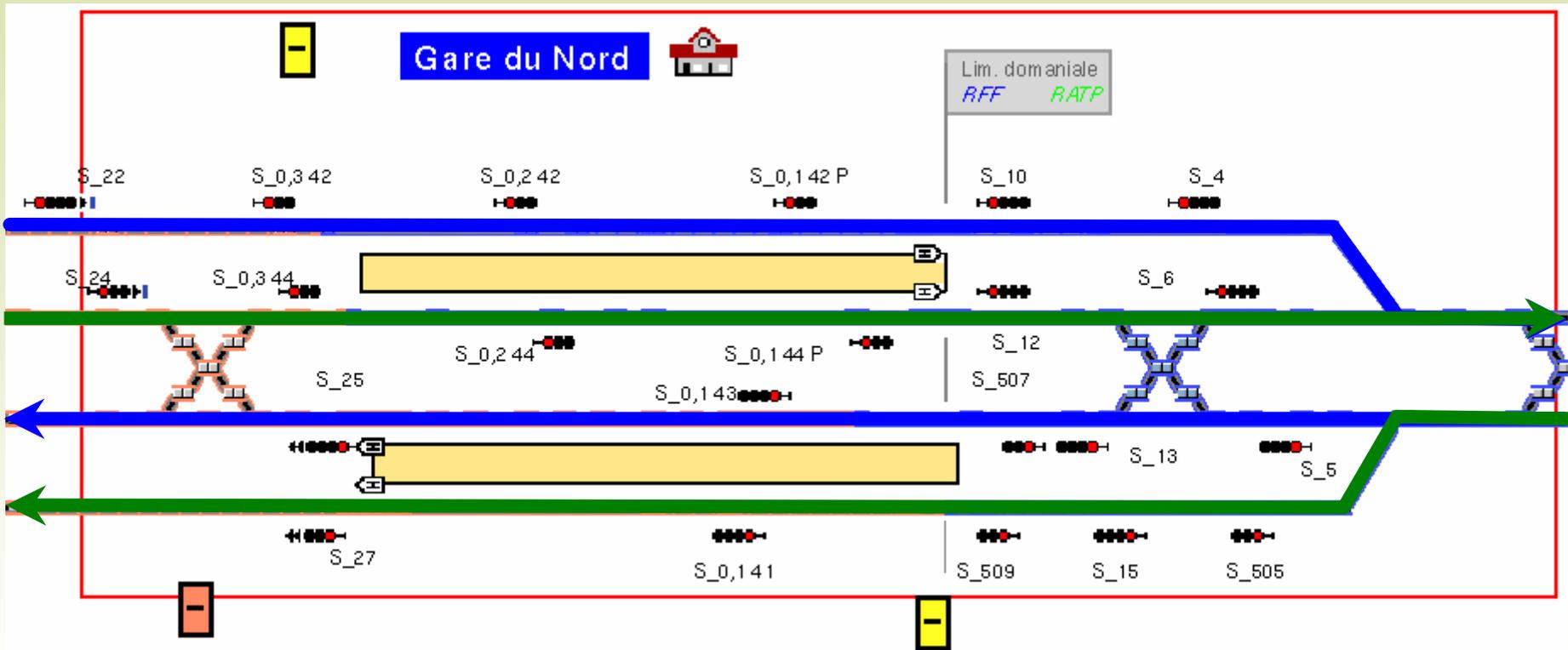


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- ☞ Dense traffic → one of the most heavily occupied railway sections in France
 - ☞ 32 trains per hour and per direction
 - ☞ Gare du Nord + Châtelet les Halles : 2 major nodes in Paris network
- ☞ Signalling system in the tunnel
 - ☞ Classic signal system : fixed block 3 aspects signalling
 - ☞ Continuous Speed Control → acceleration authorised before signal sighted
 - ☞ Different driving behaviour between SNCF and RATP personal
- ☞ Change of conductor in Gare du Nord
 - ☞ Dwell time : 2 minutes in reality, instead of 1 minute in timetable
- ☞ Major goals for regularity
 - ☞ Intention of Transport Authority : allowing more trains on the line each hour
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17/09/07 January 24th, 2008



Diagnostic and analysis of present operations, normal situation without major disturbances

☞ Theoretical timetable

- ☞ Number of trains
- ☞ Different headways (ex : a train every 3 min for line B)
- ☞ Identification of peak hours

**32 trains
p.h.p.d.
in theory**

☞ Real operating data (statistics concerning a representative period)

- ☞ Distribution of delays on arrival at stations
- ☞ Distribution of dwell times
- ☞ Use of track Z in Châtelet station
- ☞ Headways between trains

**25 trains
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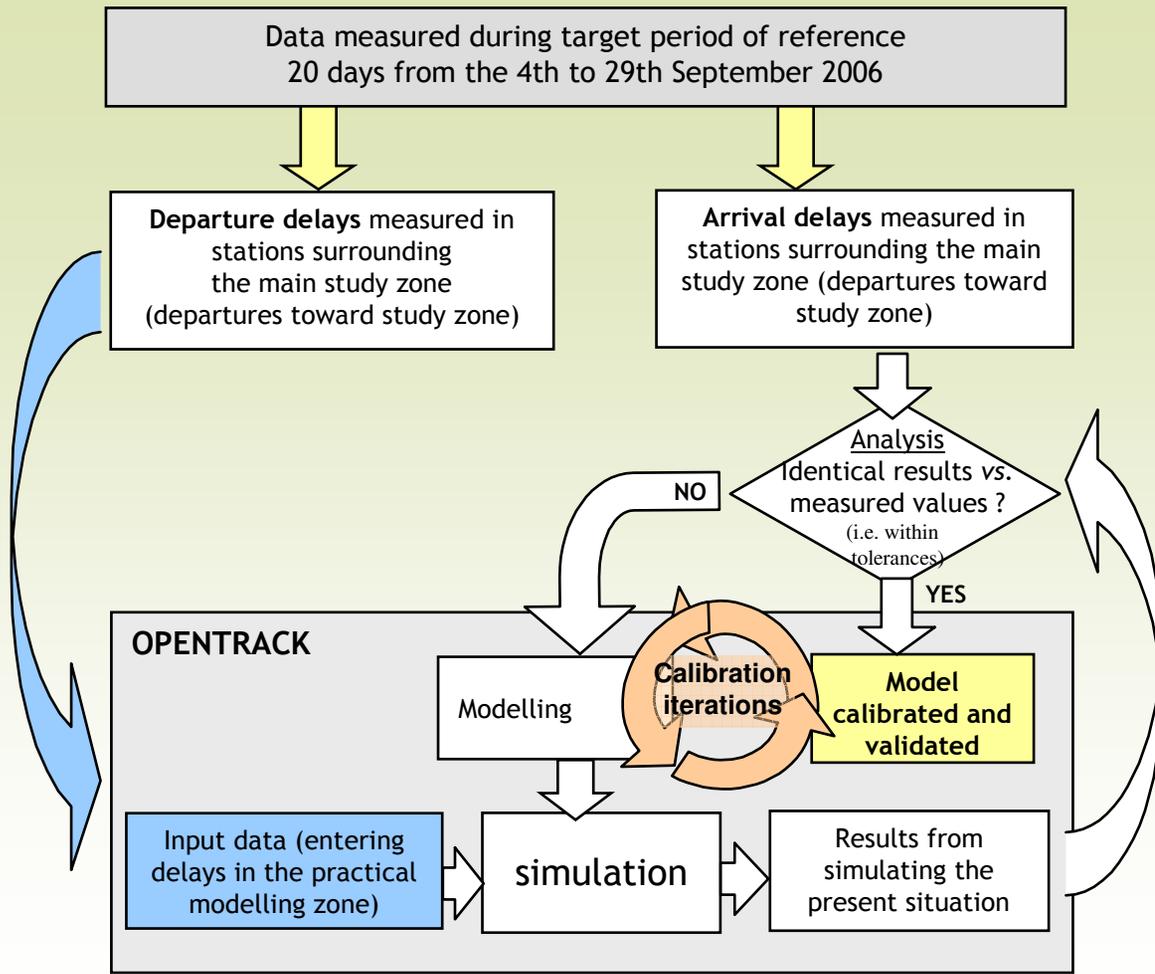
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- ☞ Tracks
- ☞ Interlocking posts
- ☞ Cab rides



5. Model calibration chart

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5. Before simulating : Model calibration

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☞ Basic definition

- ☞ Infrastructure (tracks, station platforms, speeds, signals, routes settings)
- ☞ Rolling stock (types and performances)
- ☞ Timetable

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- ☞ Extended peak hours, 06.00 - 10.00
- ☞ Filtering of circulations : from 5560 trains planned to 4920 trains used (data considered reliable)
- ☞ 20 simulation runs

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- ☞ Shortened peak period : 07.15 - 09.15
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- ☞ Delays on arrival at stations (Average, standard deviation, correlation)



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- ☞ Modelling of the following parameters, according to the scenario
 - ☞ Infrastructure
 - ☞ Initial delay (piecewise linear distribution)
 - ☞ Timetable and dwell times
 - ☞ Rolling stock

- ☞ Visualisation on screen → check of correct modelling

- ☞ Simulation : 20 runs for each scenario, without visualisation

- ☞ Statistical analysis
 - ☞ « OT_timetablestatistics.txt » file, wasn't helpful, only the last run recorded
 - ☞ Our partner, Mr Huerlimann developed a new file with the listing of 20 runs
 - ☞ Direct use of the Excel file in a specific Excel based program



6. Outputs ...

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OT_Timetable.txt - OT_Timetable.txt - Bloc notes

```

File: c:\opentrack\otoutput_scenar106\ot_timetable.txt
Produced by opentrack: Fri May 18 10:23:42 2007
Timetable
Type: OT_Text
Desc.: OT_TimetableMultiple
Scenario: Adh. outside: normal / Adh. Tunnel: normal / Delay: 1 / Global Perf.: 100.0 X / Step: 5.0 s
x-Legend: none
y-Legend: none
                    
```

Microsoft Excel - Exploît_OT_scenario6_030507.xls

F912 GDS

Run	Course	station	App. Planner [HH:MM:SS]
1	SVIC28	LPN	07:55:00
1	SVIC28	GDS	08:01:00
1	SVIC28	CLX	08:04:30
1	SVIC28	SMT	08:07:10
1	GAE45	SMT	08:32:00
1	GAE45	CLX	08:34:30
1	GAE45	GDS	08:38:00
1	GAE45	LPN	08:42:00
1	RIPA04	SFR0	08:11:00
1	RIPA04	GDS	08:17:00
1	RIPA04	CLX	08:21:35
1	RIPA04	PAA	08:25:00
1	AUPA19	PAA	08:37:00
1	AUPA19	CLX	08:41:30
1	AUPA19	GDS	08:45:35
1	AUPA19	SFR0	08:50:00
1	KNUT06	LPN	05:04:00
1	KNUT06	GDS	05:10:00
1	KNUT06	CLX	05:13:10
1	KNUT06	SMT	05:16:10
1	PAPY06	LPN	05:01:00
1	PAPY06	GDS	05:07:00
1	PAPY06	CLX	05:10:50
1	PAPY06	SMT	05:13:10
1	KNUT08	LPN	05:29:00
1	KNUT08	GDS	05:35:00
1	KNUT08	CLX	05:38:50
1	KNUT08	SMT	05:41:10
1	PAPY08	LPN	05:16:00
1	PAPY08	GDS	05:22:00
1	PAPY08	CLX	05:25:50
1	PAPY08	SMT	05:28:10
1	SVIC08	LPN	06:10:00
1	SVIC08	GDS	06:16:00
1	SVIC08	CLX	06:19:50
1	SVIC08	LPN	06:22:10
1	KNUT10	LPN	05:34:00
1	KNUT10	GDS	05:40:00
1	KNUT10	CLX	05:43:50
1	KNUT10	SMT	05:46:10
1	PAPY10	LPN	05:31:00
1	PAPY10	GDS	05:37:00
1	PAPY10	CLX	05:40:50
1	PAPY10	SMT	05:43:10
1	SVIC10	LPN	06:25:00
1	SVIC10	GDS	06:31:00
1	SVIC10	CLX	06:34:50
1	SVIC10	SMT	06:37:10
1	KNUT12	LPN	06:49:00
1	KNUT12	GDS	06:55:00
1	KNUT12	CLX	06:58:50
1	KNUT12	SMT	07:01:10
1	PAPY12	LPN	06:46:00
1	PAPY12	GDS	06:52:00

Microsoft Excel - Exploît_OT_scenario6_030507.xls

A1 EA(s)

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	EA(s)	pas =	60	s	module	HP	station =	CLX	ligne =	B	sens =	Nord-sud	type =	d'arrivée
2	522	max plage =	30	min	% valeurs	HP	station =	CLX	Chatelet	B	Nord-sud		de départ	
3	117													
4	294		0' à 1'	3	0									
5	289		1' à 2'	15	1									
6	808		2' à 3'	46	5									
7	454		3' à 4'	80	10									
8	240		4' à 5'	111	13									
9	318		5' à 6'	86	10									
10	699		6' à 7'	86	10									
11	403		7' à 8'	75	9									
12	402		8' à 9'	68	8									
13	909		9' à 10'	46	5									
14	924		10' à 11'	29	3									
15	418		11' à 12'	39	4									
16	503		12' à 13'	26	3									
17	454		13' à 14'	29	3									
18	507		14' à 15'	12	1									
19	795		15' à 16'	18	2									
20	714		16' à 17'	10	1									
21	759		17' à 18'	7	0									
22	765		18' à 19'	7	0									
23	822		19' à 20'	3	0									
24	910		20' à 21'	1	0									
25	759		21' à 22'	0	0									
26	961		22' à 23'	1	0									
27	569		23' à 24'	1	0									
28	618		24' à 25'	1	0									
29	409													

Sens Nord > Sud Chatelet-les-Halles - ligne B

5 min

25% 75%
67% 33%

■ Situation de référence
■ Scénario 2 : suppression de relève conducteur



7. Interesting scenarios

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- ☞ Short term scenario : Turnaround at Châtelet-les-Halles using track Z
 - ☞ Line RER D : lower traffic in the tunnel
 - 4 trains / 12 stop at Châtelet les Halles, on a dedicated track (voie Z)
 - 8 trains remaining in the tunnel each hour
 - ☞ Line RER B : all trains continuing in the tunnel (20 each peak hour)

- ☞ Short term scenario : Suppression of driver change
 - ☞ Only line B concerned, today both operated by SNCF and RATP in their perimeter
 - ☞ Harmonization of driving behaviors in the tunnel (start on « yellow » warning signals)
 - ☞ Reduction of dwell times for RER B in Gare du Nord (= Châtelet times)

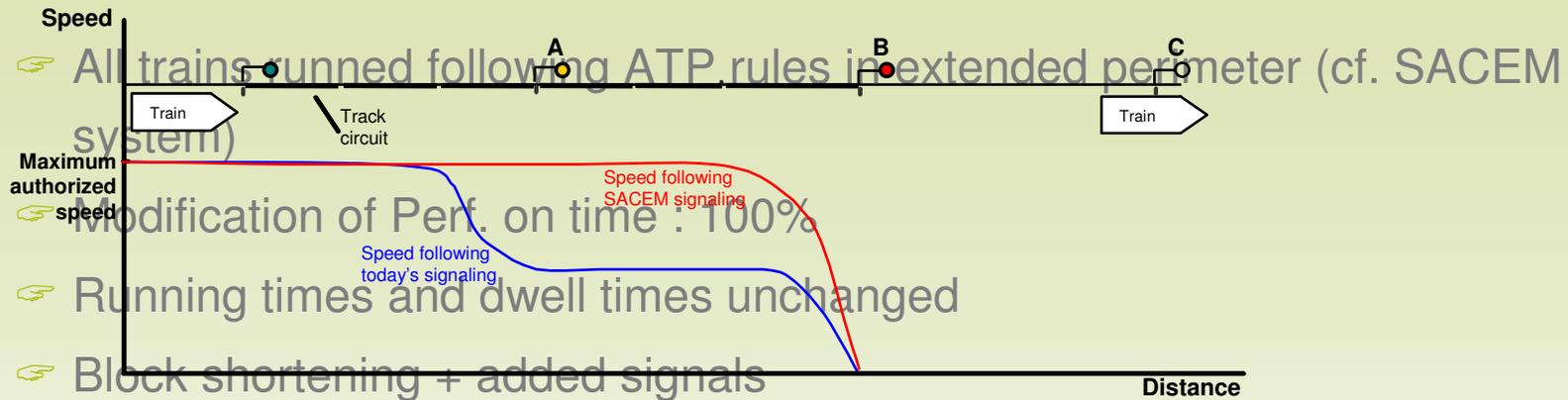


7. Interesting scenarios

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Mid term scenario : Automated driving



Rail switch in Gare du Nord

- > South : allowing RER B on tracks originally dedicated to RER D
- > North : possible track interchange for both line
- Running times and dwell times unchanged
- Adding priorities



8. Conclusion

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☞ Specificity of the study

- ☞ 40 modelled scenarios with OT (27 « officialy » ordered by client)
- ☞ A 18 months study, 6 sessions of simulation
- ☞ OT : a tool for concensus between authority and operators
- ☞ Statistical approach of the problem

☞ Possible improvements

- ☞ Different boarding-unboarding times according to rolling stock
- ☞ Interface with other simulation software (i.e. : Simwalk)
- ☞ Definition of crowds on platform : impact on dwell times



End ...

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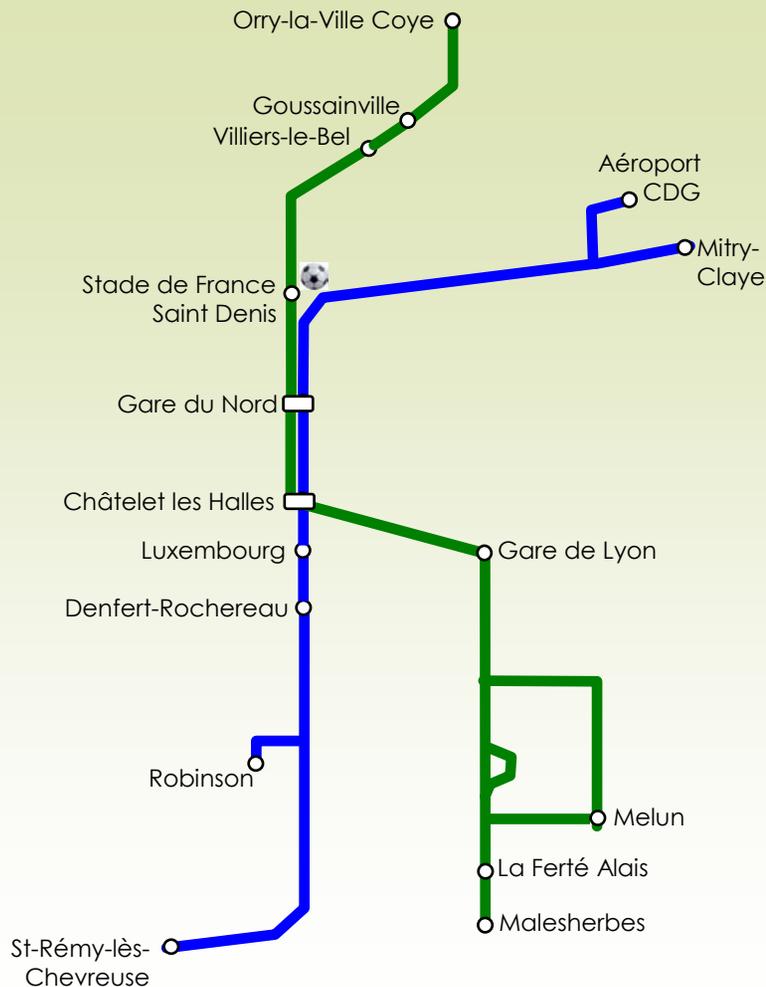
Thank you for your attention !!!

I'm available for your questions



Brief history of line RER B and RER D

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- **From 1846 : historical « ligne de Sceaux » ending first at Denfert-Rochereau, later at Luxembourg,**
- **1977 : continuation under the Seine river, until Châtelet les Halles,**
- **1981 : opening of the Châtelet – Gare du Nord tunnel**
- **1983 : junction with Roissy-Rail airport courses and the Mitry – Gare du Nord line = today's line B**

- **1987 → 1990 : trains coming from Villiers le Bel, Goussainville and Orry la Ville stopping first at Gare du Nord, extended at Châtelet les Halles (via existing tunnel)**
- **1995 : opening of the Châtelet – Gare de Lyon underground section, trains heading toward Melun, La Ferté-Alais and Malesherbes**
- **1998 : opening of Stade de France Saint-Denis station**

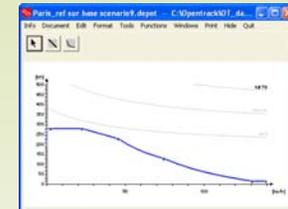


Rolling stock involved in the tunnel

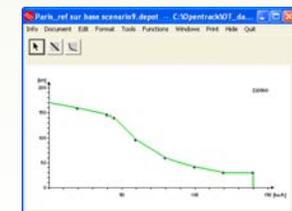
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- Date of construction : 1980-1983
- V max : 140 km/h
- Max passenger capacity : 843 p.
- Length : 104 m
- Weight : 283 T
- Concerned line : RER B
(also running on line A)

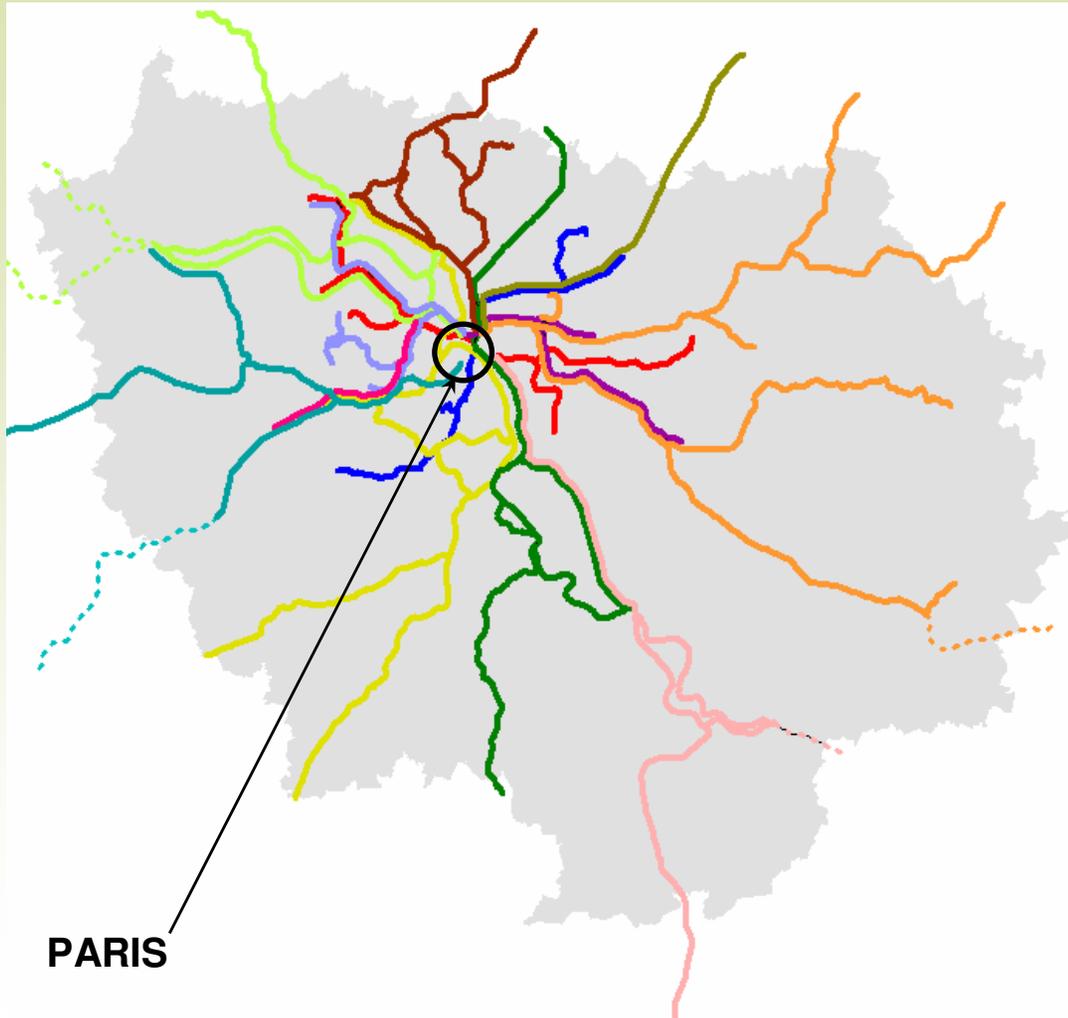


- Date of construction : 1988 - 1998
- V max : 140 km/h
- Max passenger capacity : 1413 p.
- Length : 129 m
- Weight : 381 T
- Concerned line : RER D



Ile-de-France regional rail network

17/09/07 January 24th, 2008



- Réseau Express Régional
- Strong and identified network
- Paris underground cross-over
- 2 operators : RATP + SNCF



- SNCF operation (Transilien)
- Basic commuter lines
- Terminus in 6 main stations
- Possible shared trunks with RER lines



7. Other scenarios – selected list

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☞ Basic scenarios

- ☞ Equal RS performances for both lines
- ☞ Modification of line D headway
- ☞ 2nd tunnel between surrounding stations
- ☞ Modification of injection following improvements outside perimeter

☞ Combined scenarios



What is Egis Rail ?

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Europe's major financial institution, N°1 French financial group



A French consulting, engineering and operating firm, dedicated to development infrastructures



Rail and transit consultants and engineers, formerly named SEMALY, created in 1968

Covering all types of transport projects

- Metro
- Light Rail Transit
- Conventional Rail
- High Speed Lines

For the benefit of

- Ministries of Transport
- Regional or City Authorities
- Operators
- Private Consortia, etc...



Egis Rail ? Range of services

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- Planning studies, Consultancy and Audits
- Design
- Procurement assistance
- Construction management and supervision
- Manufacturing control
- Testing and commissioning
- Maintenance management



Egis Rail ? References



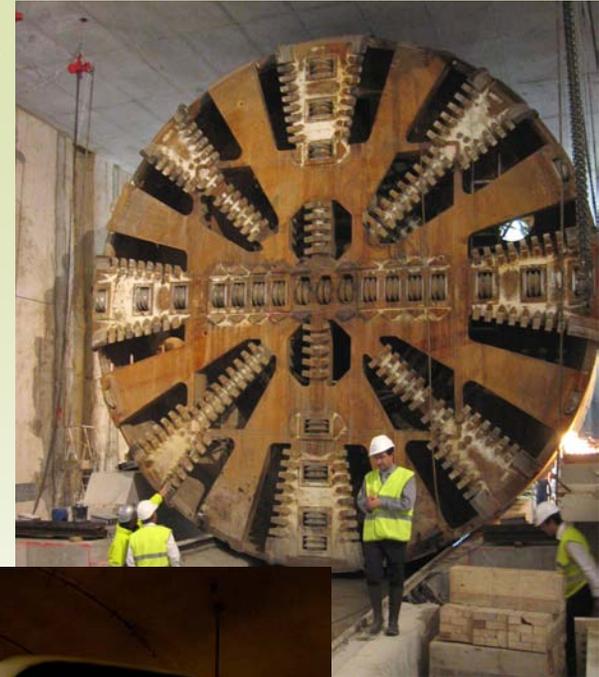
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METRO



LYON : whole network
(line D, fully automated)

Tunnel boring
machine



MARSEILLES
Extension of the network



Egis Rail ? References



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☞ LIGHT RAIL TRANSIT



DUBLIN: Technical Design
& Construction Management



KRAKOW : design assistance
and construction supervision



OPORTO: integrated engineering
within a private Consortium



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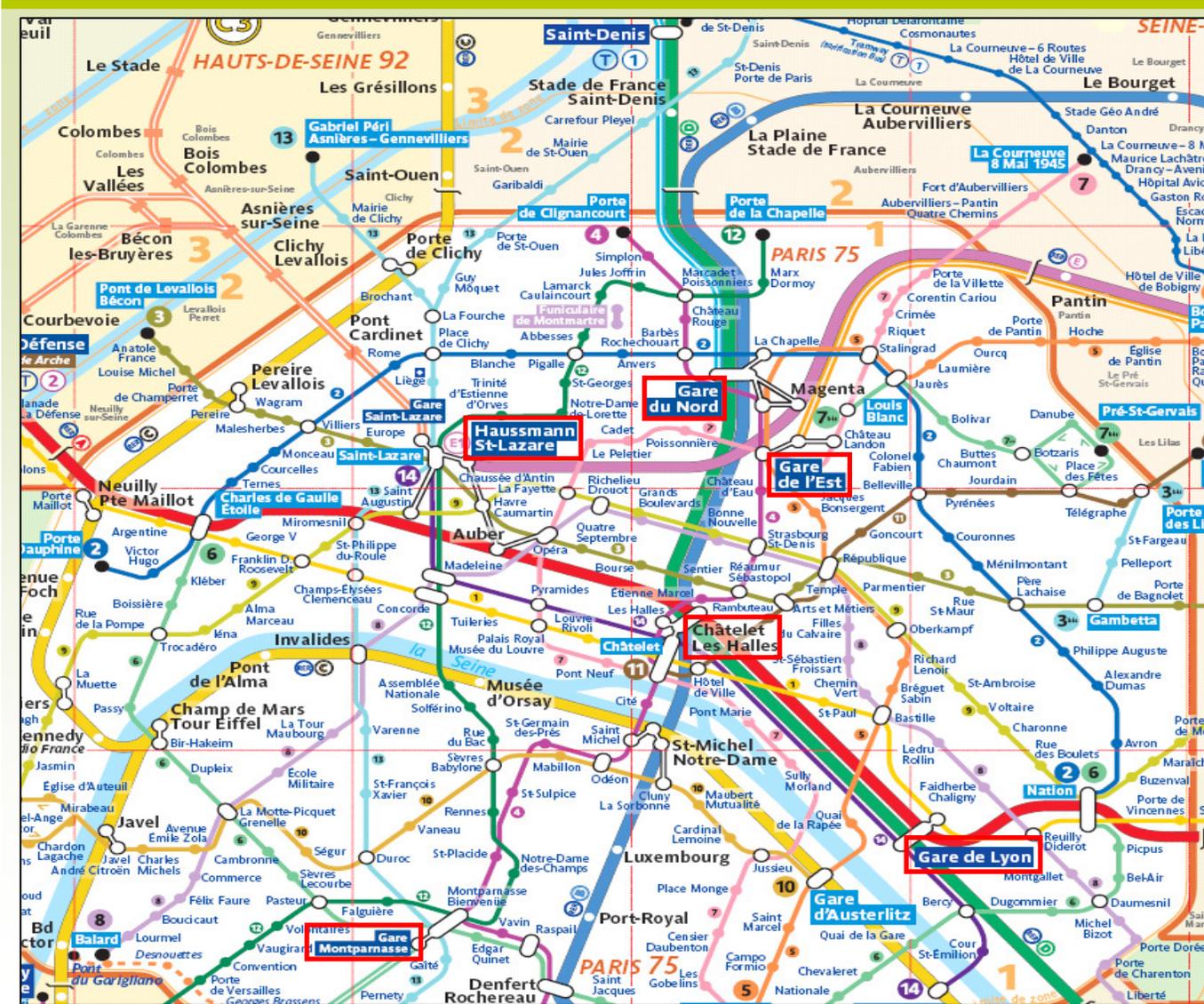


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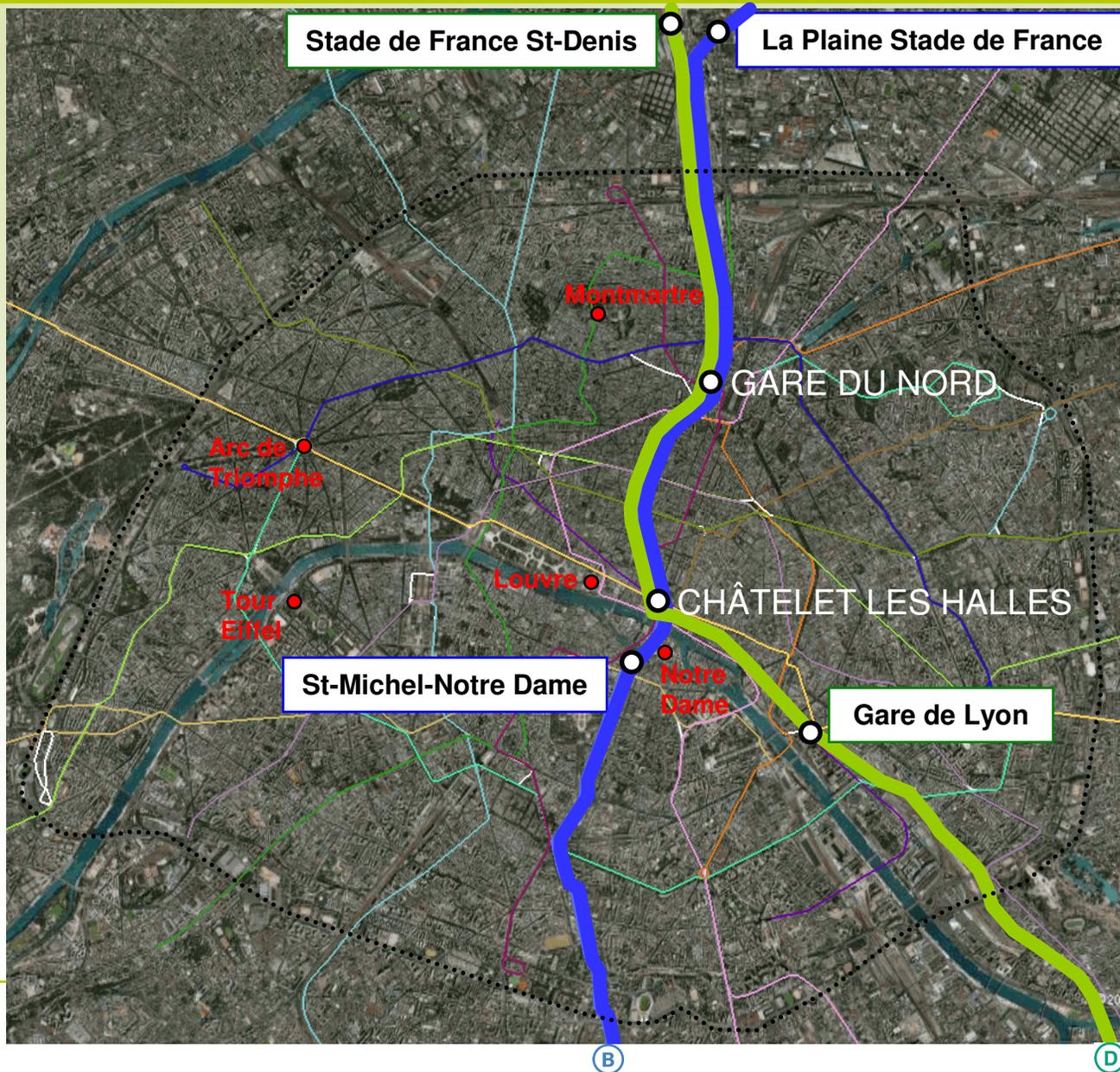
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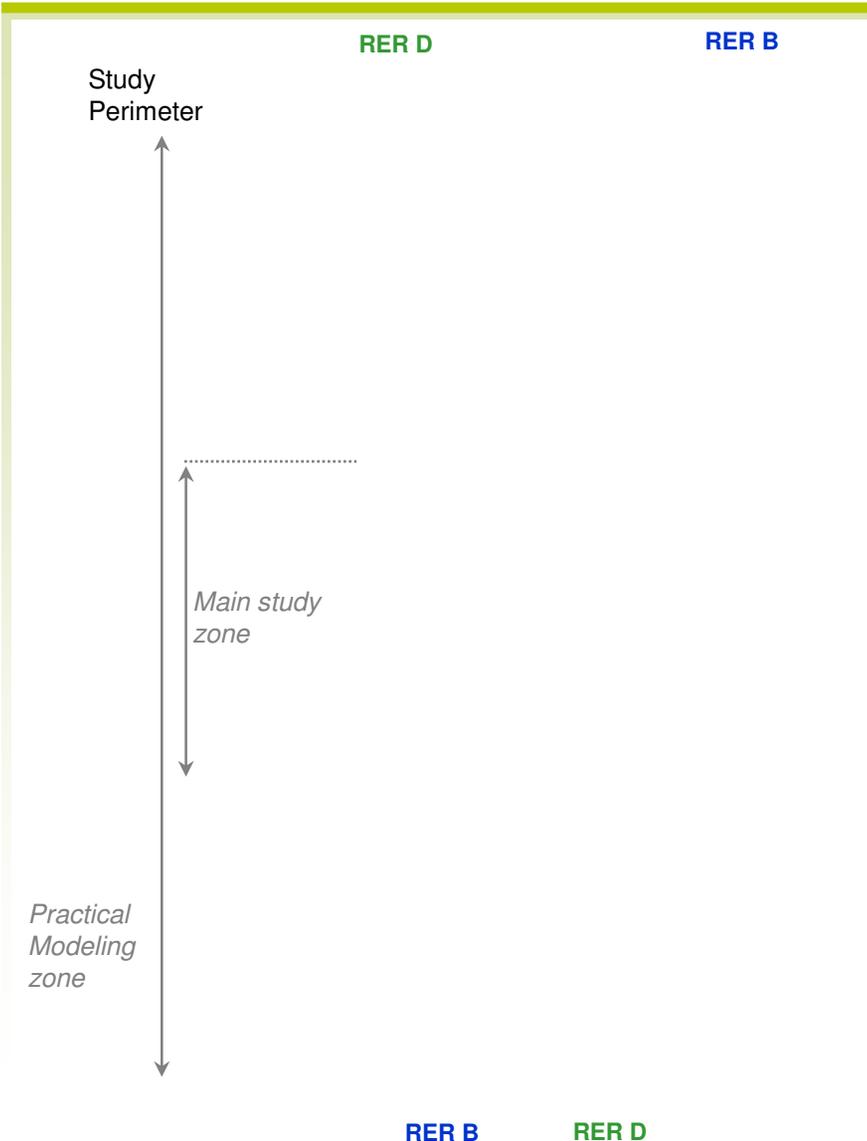
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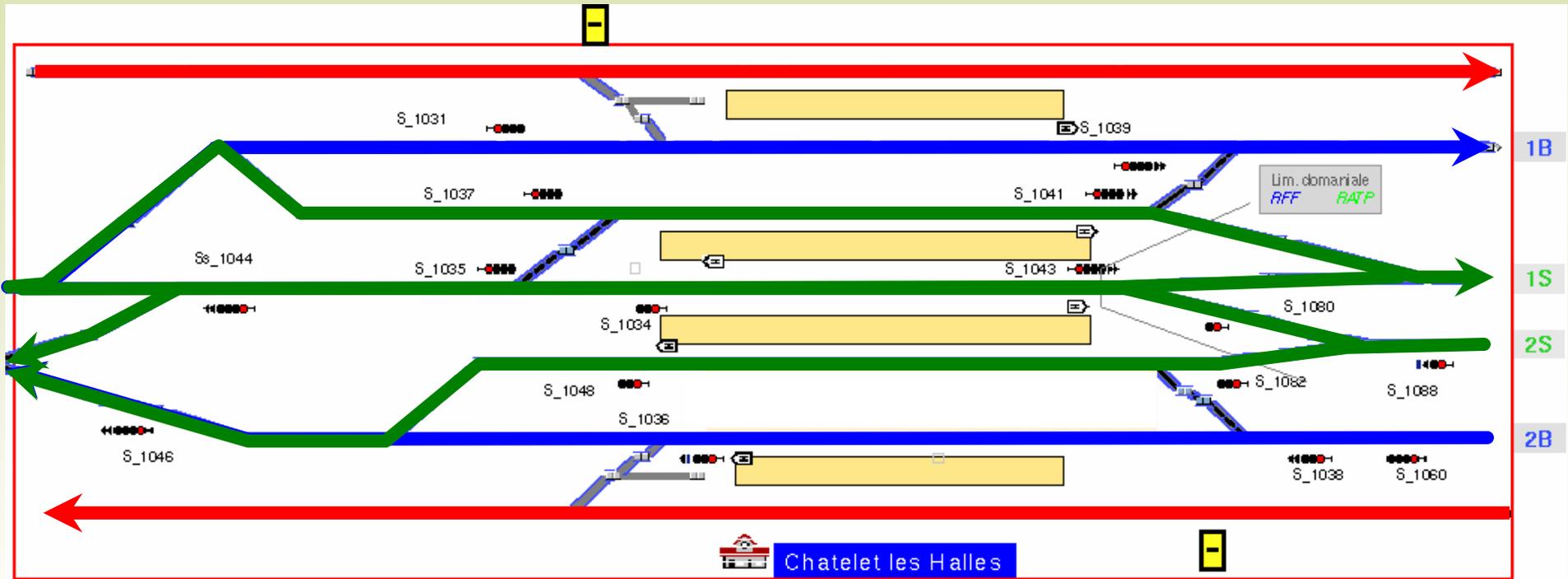


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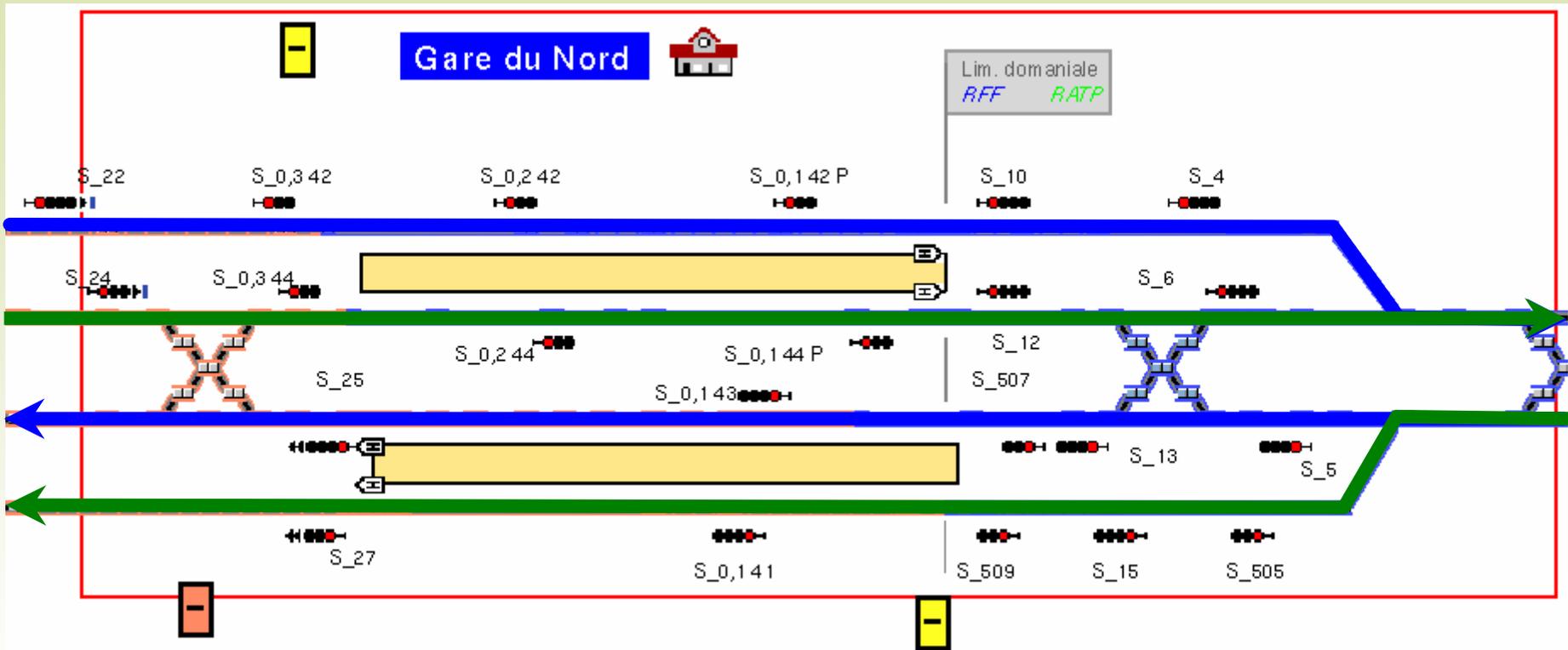


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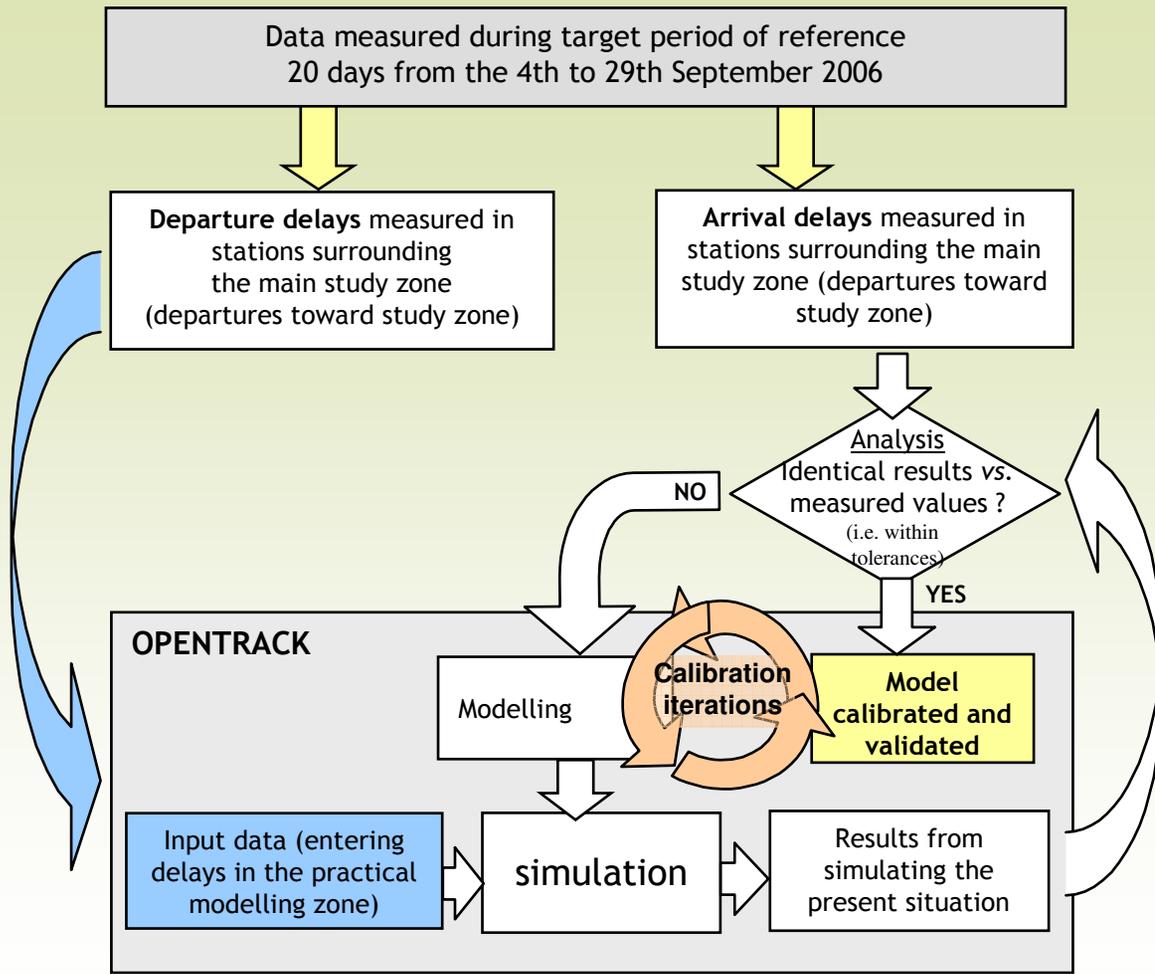
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6. Outputs ...

17/09/07 January 24th, 2008



OT_Timetable.txt - OT_Timetable.txt - Bloc notes

```

File: c:\opentrack\otoutput_scenar106\ot_timetable.txt
Produced by opentrack: Fri May 18 10:23:42 2007
Timetable
Type : OT_Text
Desc. : OT_TimetableMultiple
Scenario: Adh. outside: normal / Adh. Tunnel: normal / Delay: 1 / Global Perf.: 100.0 X / Step: 5.0 s
x-Legend: none
y-Legend: none
                    
```

Microsoft Excel - Exploît_OT_scenario6_030507.xls

F912 GDS

Run	Course	station	App. Planner [HH:MM:SS]
1	SVIC28	LPN	07:55:00
1	SVIC28	GDS	08:01:00
1	SVIC28	CLX	08:04:30
1	SVIC28	SMT	08:07:10
1	GAE45	SMT	08:32:00
1	GAE45	CLX	08:34:30
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1	KNUT06	CLX	05:13:10
1	KNUT06	SMT	05:16:10
1	PAPY06	LPN	05:01:00
1	PAPY06	GDS	05:07:00
1	PAPY06	CLX	05:10:50
1	PAPY06	SMT	05:13:10
1	KNUT08	LPN	05:29:00
1	KNUT08	GDS	05:35:00
1	KNUT08	CLX	05:39:50
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1	KNUT10	LPN	05:34:00
1	KNUT10	GDS	05:40:00
1	KNUT10	CLX	05:44:30
1	KNUT10	SMT	05:48:10
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Sens Nord > Sud Chatelet-les-Halles - ligne B

5 min

25% 75%
67% 33%

■ Situation de référence
■ Scénario 2 : suppression de relève conducteur



7. Interesting scenarios

17/09/07 January 24th, 2008



- ☞ Short term scenario : Turnaround at Châtelet-les-Halles using track Z
 - ☞ Line RER D : lower traffic in the tunnel
 - 4 trains / 12 stop at Châtelet les Halles, on a dedicated track (voie Z)
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- ☞ Short term scenario : Suppression of driver change
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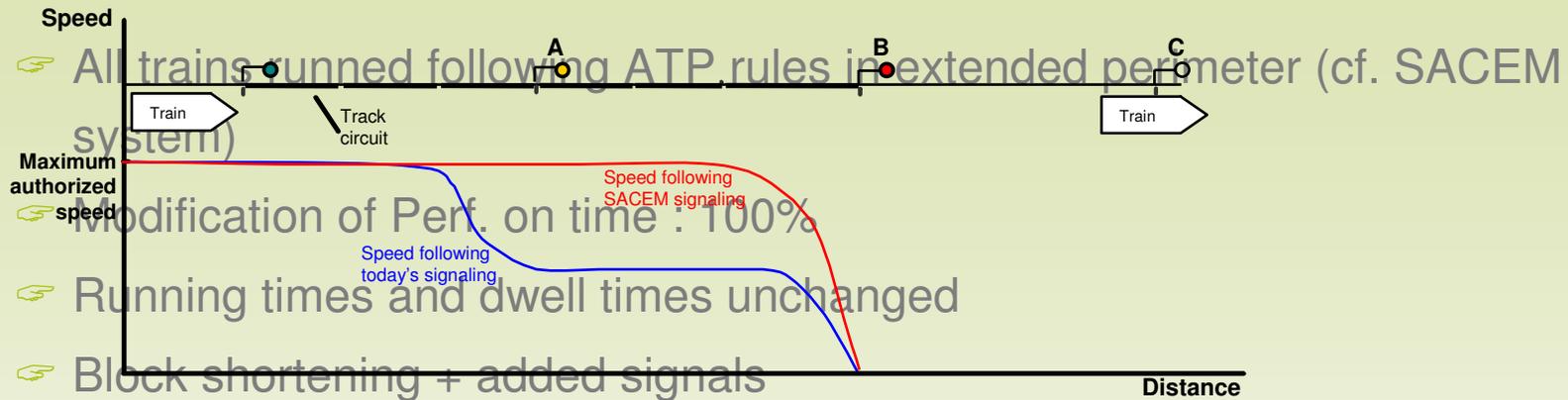


7. Interesting scenarios

17/09/07 January 24th, 2008



Mid term scenario : Automated driving



Rail switch in Gare du Nord

- ☞ > South : allowing RER B on tracks originally dedicated to RER D
- ☞ > North : possible track interchange for both line
- ☞ Running times and dwell times unchanged
- ☞ Adding priorities



8. Conclusion

17/09/07 January 24th, 2008



☞ Specificity of the study

- ☞ 40 modelled scenarios with OT (27 « officialy » ordered by client)
- ☞ A 18 months study, 6 sessions of simulation
- ☞ OT : a tool for concensus between authority and operators
- ☞ Statistical approach of the problem

☞ Possible improvements

- ☞ Different boarding-unboarding times according to rolling stock
- ☞ Interface with other simulation software (i.e. : Simwalk)
- ☞ Definition of crowds on platform : impact on dwell times



End ...

17/09/07 January 24th, 2008



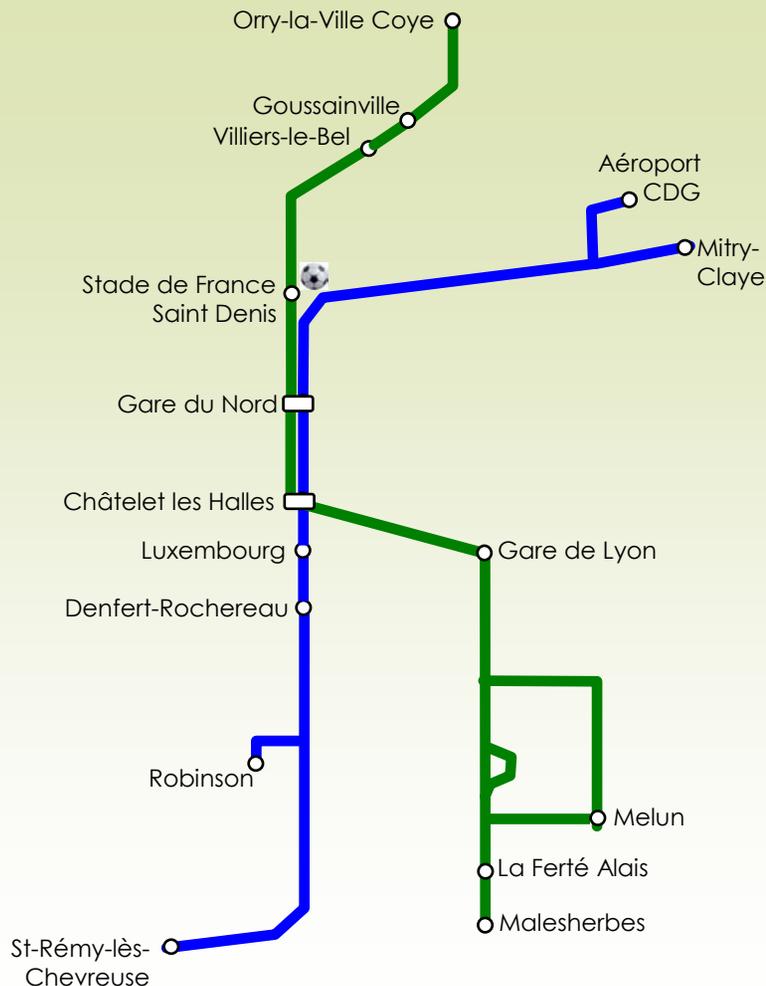
Thank you for your attention !!!

I'm available for your questions



Brief history of line RER B and RER D

17/09/07 January 24th, 2008



- **From 1846 : historical « ligne de Sceaux » ending first at Denfert-Rochereau, later at Luxembourg,**
- **1977 : continuation under the Seine river, until Châtelet les Halles,**
- **1981 : opening of the Châtelet – Gare du Nord tunnel**
- **1983 : junction with Roissy-Rail airport courses and the Mitry – Gare du Nord line = today's line B**

- **1987 → 1990 : trains coming from Villiers le Bel, Goussainville and Orry la Ville stopping first at Gare du Nord, extended at Châtelet les Halles (via existing tunnel)**
- **1995 : opening of the Châtelet – Gare de Lyon underground section, trains heading toward Melun, La Ferté-Alais and Malesherbes**
- **1998 : opening of Stade de France Saint-Denis station**

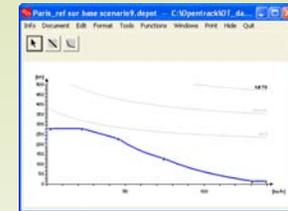


Rolling stock involved in the tunnel

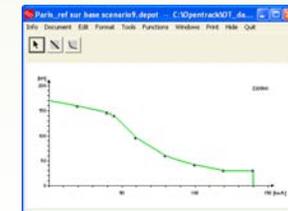
17/09/07 January 24th, 2008



- Date of construction : 1980-1983
- V max : 140 km/h
- Max passenger capacity : 843 p.
- Length : 104 m
- Weight : 283 T
- Concerned line : RER B
(also running on line A)

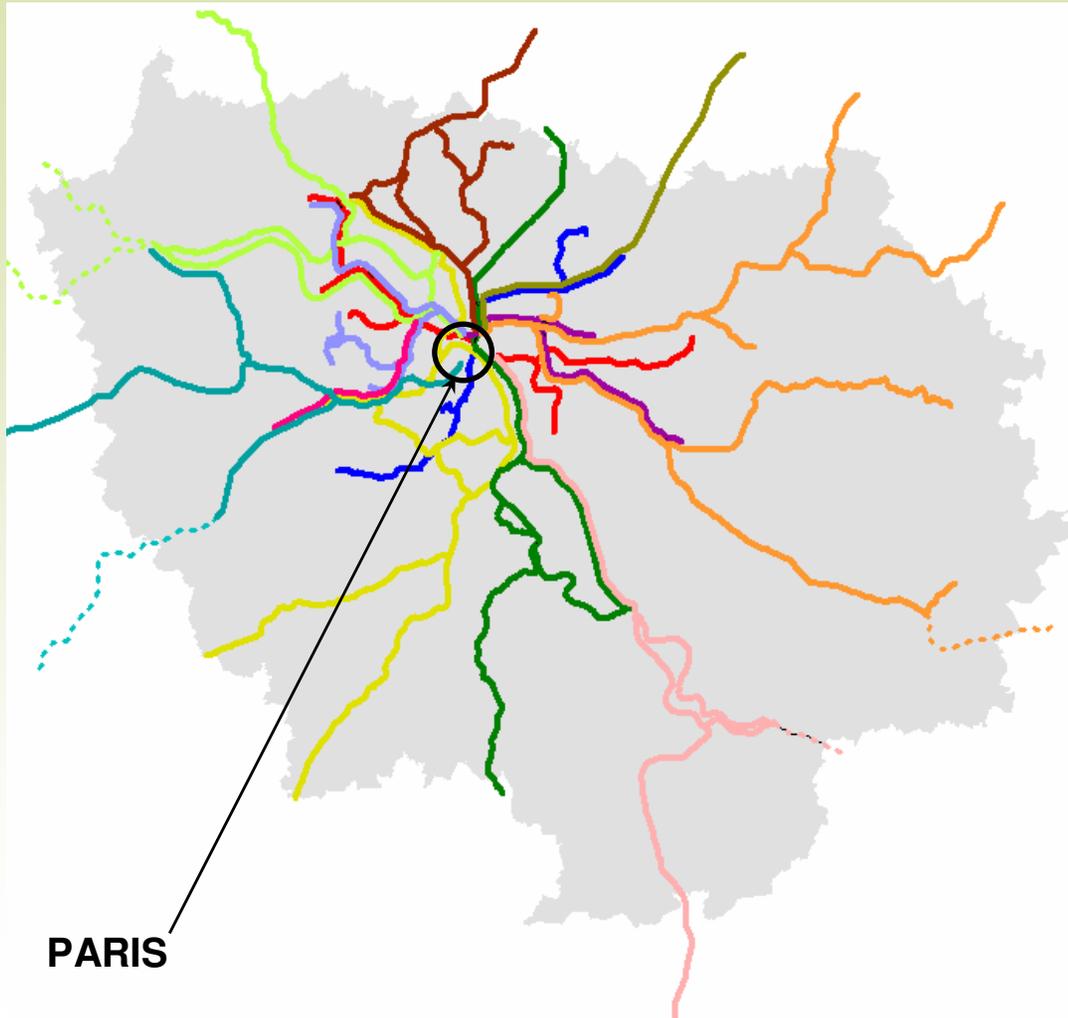


- Date of construction : 1988 - 1998
- V max : 140 km/h
- Max passenger capacity : 1413 p.
- Length : 129 m
- Weight : 381 T
- Concerned line : RER D



Ile-de-France regional rail network

17/09/07 January 24th, 2008



- Réseau Express Régional
- Strong and identified network
- Paris underground cross-over
- 2 operators : RATP + SNCF



- SNCF operation (Transilien)
- Basic commuter lines
- Terminus in 6 main stations
- Possible shared trunks with RER lines



7. Other scenarios – selected list

17/09/07 January 24th, 2008



☞ Basic scenarios

- ☞ Equal RS performances for both lines
- ☞ Modification of line D headway
- ☞ 2nd tunnel between surrounding stations
- ☞ Modification of injection following improvements outside perimeter

☞ Combined scenarios



What is Egis Rail ?

17/09/07 January 24th, 2008



Europe's major financial institution, N°1 French financial group



A French consulting, engineering and operating firm, dedicated to development infrastructures



Rail and transit consultants and engineers, formerly named SEMALY, created in 1968

Covering all types of transport projects

- Metro
- Light Rail Transit
- Conventional Rail
- High Speed Lines

For the benefit of

- Ministries of Transport
- Regional or City Authorities
- Operators
- Private Consortia, etc...



Egis Rail ? Range of services

17/09/07 January 24th, 2008



- Planning studies, Consultancy and Audits
- Design
- Procurement assistance
- Construction management and supervision
- Manufacturing control
- Testing and commissioning
- Maintenance management



Egis Rail ? References



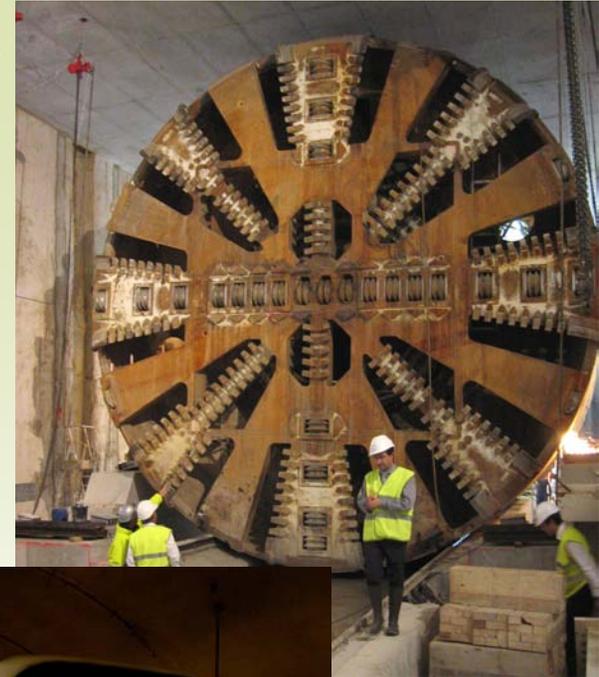
17/09/07 January 24th, 2008

METRO



LYON : whole network
(line D, fully automated)

Tunnel boring
machine



MARSEILLES
Extension of the network



Egis Rail ? References



17/09/07 January 24th, 2008

☞ LIGHT RAIL TRANSIT



DUBLIN: Technical Design
& Construction Management



KRAKOW : design assistance
and construction supervision



OPORTO: integrated engineering
within a private Consortium



OpenTrack simulation for suburban tunnel in Paris (RER B & D)

Presentation
Opentrack – Viriato workshop
January 24th, 2008
Zurich, Switzerland



Table of contents

17/09/07 January 24th, 2008

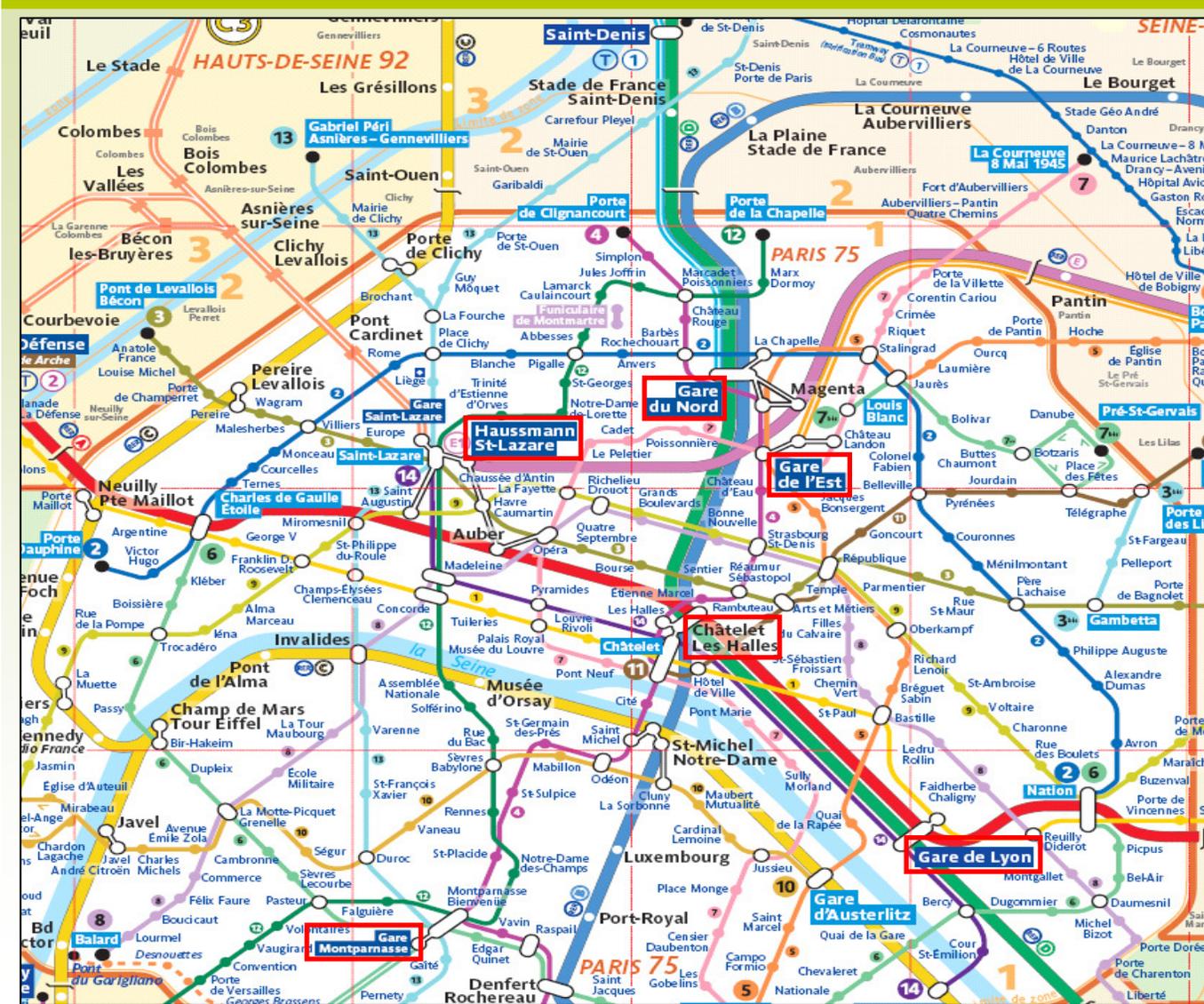


- ▶ **Introduction**
- ▶ **Overall context**
- ▶ **Main technical data**
- ▶ **Major stakes**
- ▶ **Before simulating : our method**
- ▶ **Simulation in several steps**
- ▶ **Interesting scenarios**
- ▶ **Conclusion**



1. Introduction : Dense transport network

17/09/07 January 24th, 2008



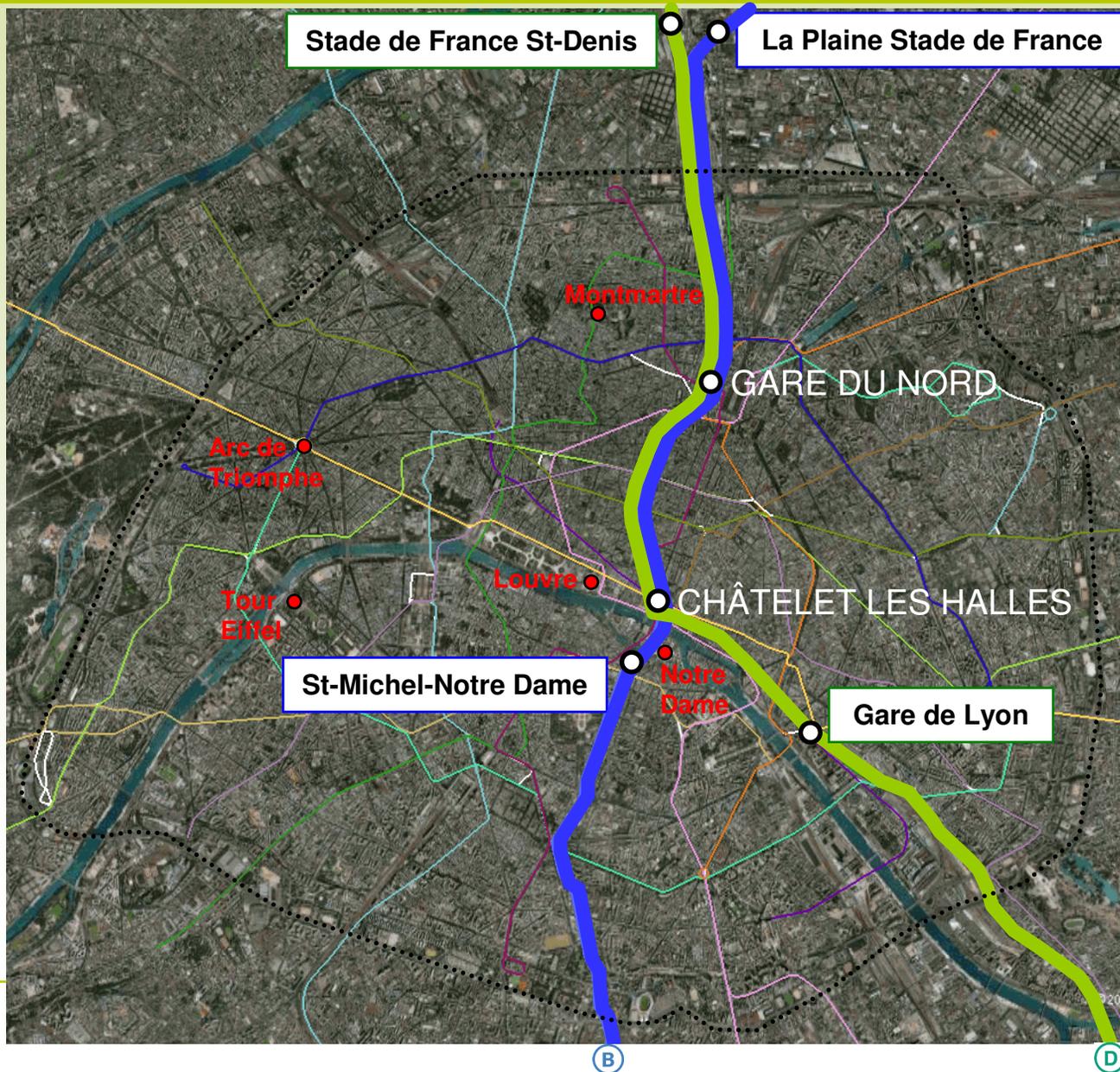
Inside Paris

- **Underground :**
16 lines (1 automated),
211 km, 300 stations
- **Regional trains crossing the city :**
5 lines, 31 stations



1. Introduction : Project location

17/09/07 January 24th, 2008



Gare du Nord +
Châtelet les Halles :
2 major nodes in
the Paris transport
network



3

2. Overall context

17/09/07 January 24th, 2008



- ☞ Operating problem :
 - ☞ Convergence of 2 overcrowded lines on the same double track tunnel
 - ☞ Regularity and customer satisfaction declining
 - ☞ Choices to be made by the Transport Authority to improve fluidity

- ☞ Client : Syndicat des Transports d'Ile de France (STIF)

- ☞ Transport authority of Ile de France region



- ☞ Technical partners : the operators running trains in the tunnel

- ☞ RATP (Paris region transport company) → southern part of line B



- ☞ SNCF : National railway company → northern part of line B & line D



- ☞ Support : Mr Huerlimann – OpenTrack GmbH

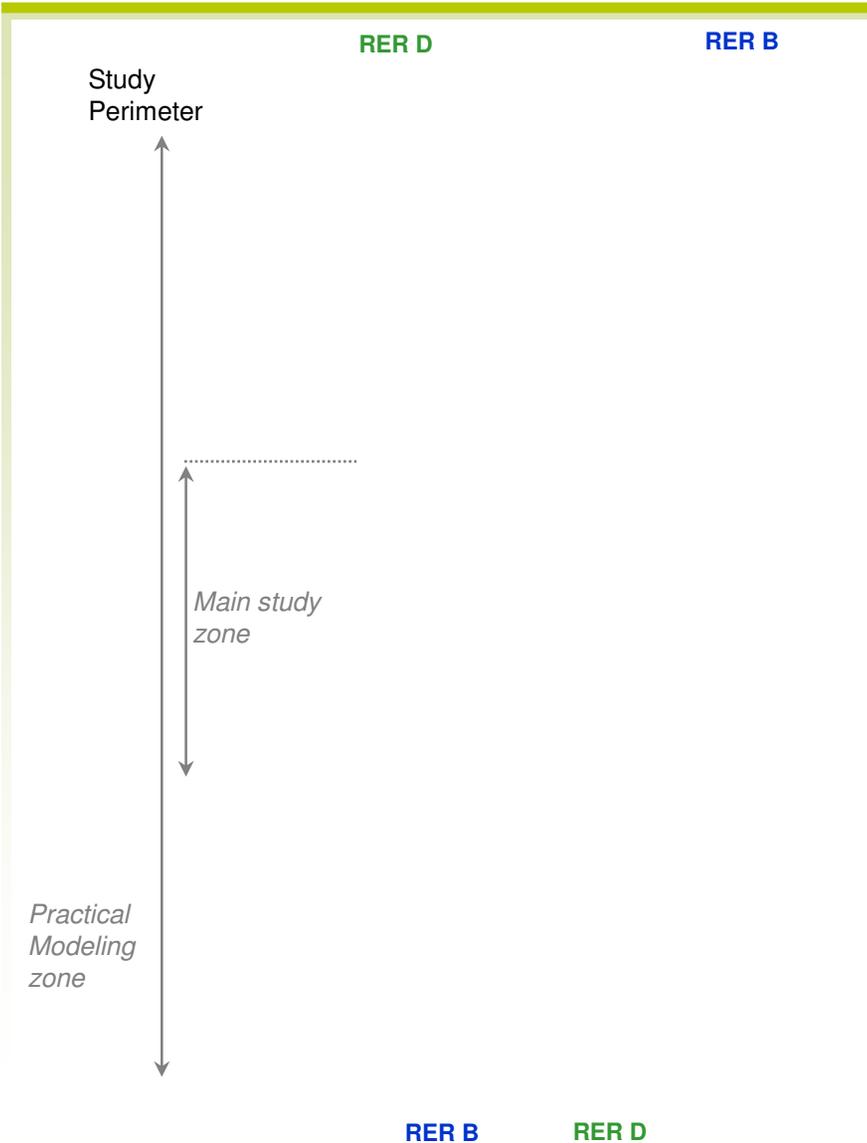
OPENTRACK



3. Main technical data



17/09/07 January 24th, 2008



- ☞ Timetable : 32 trains per hour per direction = 20 trains line B + 12 trains line D
- ☞ Headway : 90 secondes, theoretical headway < 90 sec
- ☞ Two controlling stations (RATP & SNCF)
- ☞ Two types of rolling stock
- ☞ Two electrical power supply systems (change at Gare du Nord)
- ☞ Driver change for line B at Gare du Nord (change between RATP and SNCF)
- ☞ Use of an « extra track » in Châtelet station, called « voie Z » by line D.

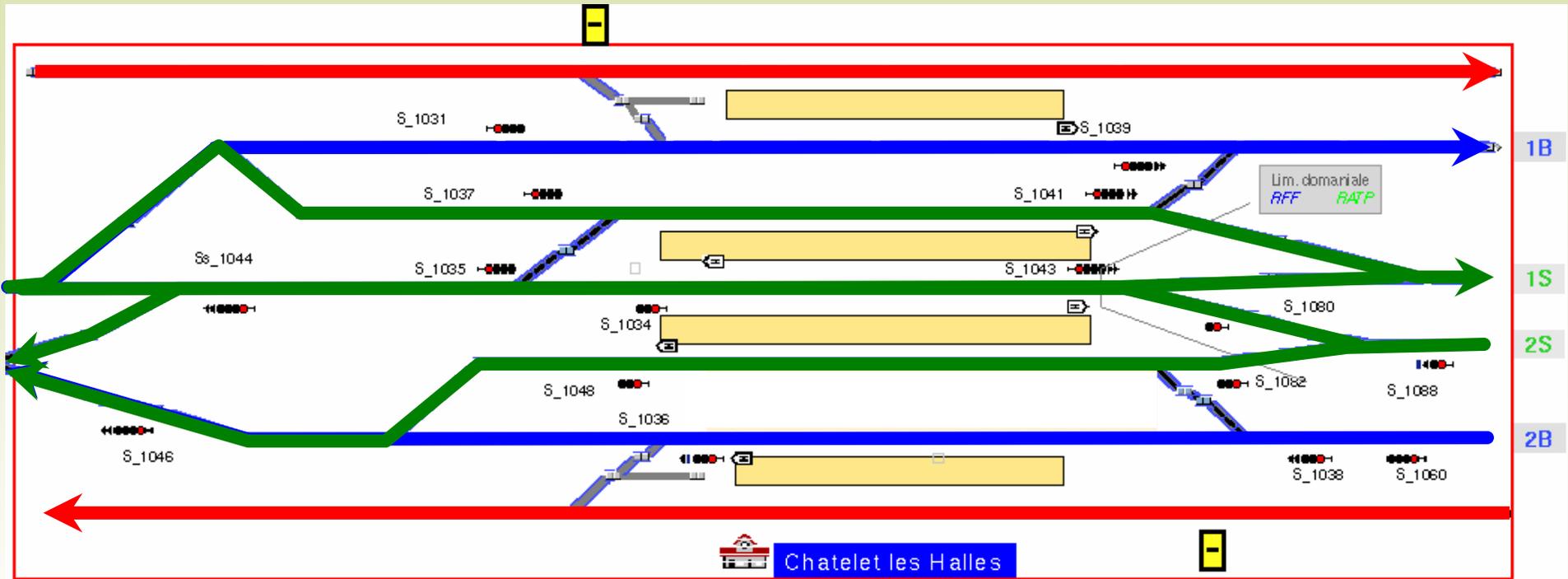


3. Main technical data

17/09/07 January 24th, 2008



Focus on station : Châtelet-les-Halles



(north) La Plaine Stade de France ⇐



⇒ St Michel Notre Dame (south)

(north) Stade de France – St Denis ⇐



⇒ Paris Gare de Lyon (south)



Not simulated

Dedicated tracks in the station – No interactions with lines B & D

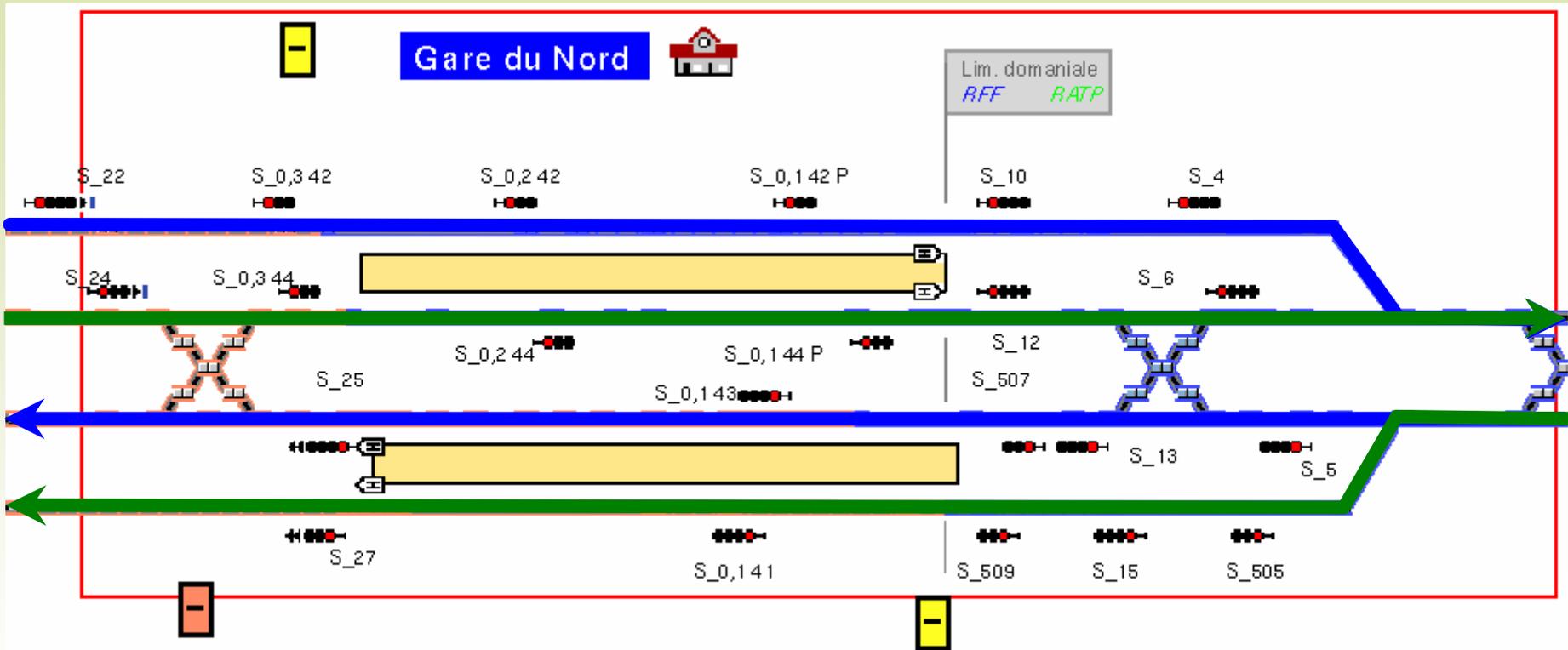


3. Main technical data

17/09/07 January 24th, 2008



Focus on station : Gare du Nord



(north) La Plaine Stade de France ⇐  ⇒ St Michel Notre Dame (south)
 (north) Stade de France – St Denis ⇐  ⇒ Paris Gare de Lyon (south)



4. Major stakes

17/09/07 January 24th, 2008



- ☞ Dense traffic → one of the most heavily occupied railway sections in France
 - ☞ 32 trains per hour and per direction
 - ☞ Gare du Nord + Châtelet les Halles : 2 major nodes in Paris network
- ☞ Signalling system in the tunnel
 - ☞ Classic signal system : fixed block 3 aspects signalling
 - ☞ Continuous Speed Control → acceleration authorised before signal sighted
 - ☞ Different driving behaviour between SNCF and RATP personal
- ☞ Change of conductor in Gare du Nord
 - ☞ Dwell time : 2 minutes in reality, instead of 1 minute in timetable
- ☞ Major goals for regularity
 - ☞ Intention of Transport Authority : allowing more trains on the line each hour
 - ☞ Today : every peak hour, 2 trains cancelled by direction



5. Before simulating : Present situation

17/09/07 January 24th, 2008



Diagnostic and analysis of present operations, normal situation without major disturbances

☞ Theoretical timetable

- ☞ Number of trains
- ☞ Different headways (ex : a train every 3 min for line B)
- ☞ Identification of peak hours

**32 trains
p.h.p.d.
in theory**

☞ Real operating data (statistics concerning a representative period)

- ☞ Distribution of delays on arrival at stations
- ☞ Distribution of dwell times
- ☞ Use of track Z in Châtelet station
- ☞ Headways between trains

**25 trains
p.h.p.d. in
reality**

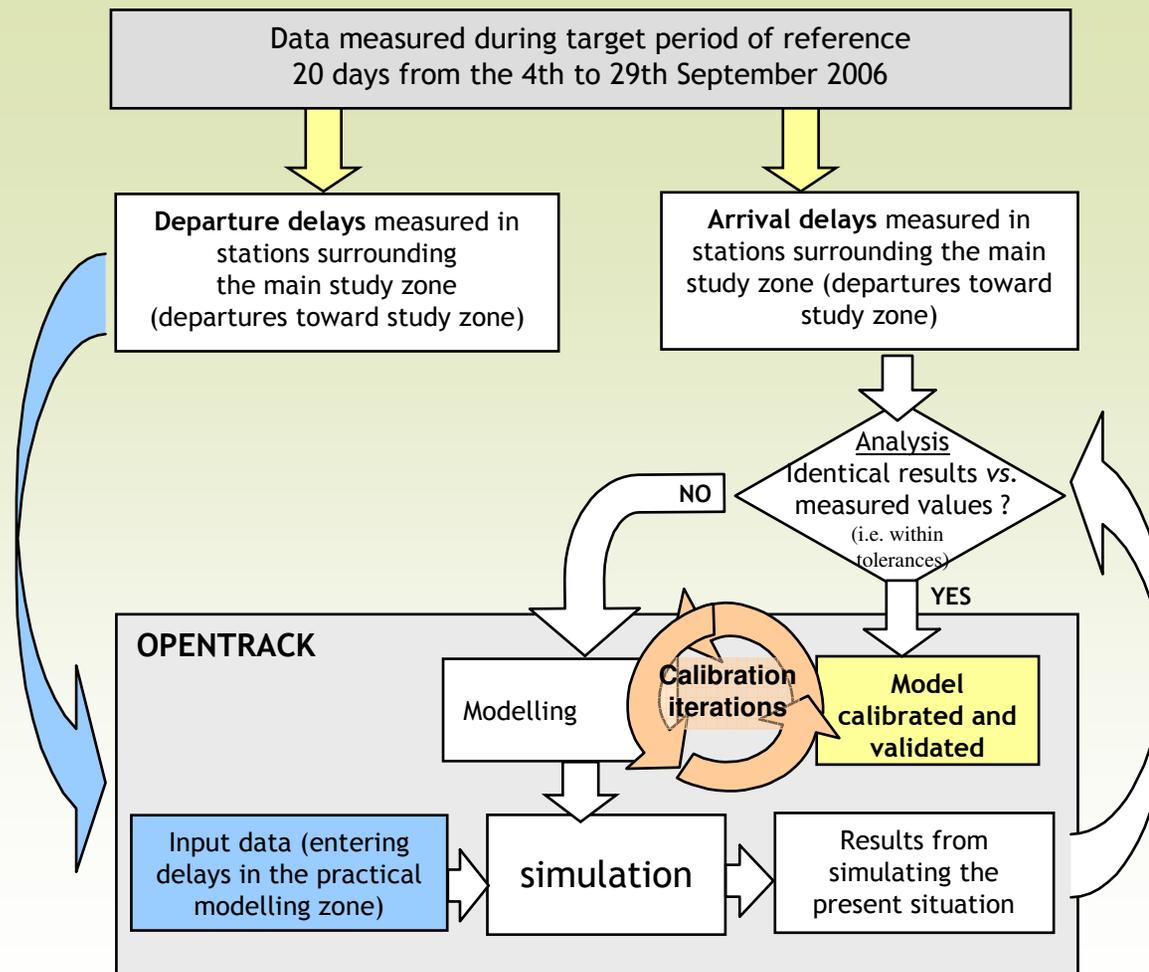
☞ Site visits

- ☞ Tracks
- ☞ Interlocking posts
- ☞ Cab rides



5. Model calibration chart

17/09/07 January 24th, 2008



5. Before simulating : Model calibration

17/09/07 January 24th, 2008



☞ Basic definition

- ☞ Infrastructure (tracks, station platforms, speeds, signals, routes settings)
- ☞ Rolling stock (types and performances)
- ☞ Timetable

☞ Calibration method

- ☞ Extended peak hours, 06.00 - 10.00
- ☞ Filtering of circulations : from 5560 trains planned to 4920 trains used (data considered reliable)
- ☞ 20 simulation runs

☞ Calibration criteria

- ☞ Shortened peak period : 07.15 - 09.15
- ☞ Filtering of circulations : from 4920 trains to 2145 trains in that specific period
- ☞ Delays on arrival at stations (Average, standard deviation, correlation)



5. Before simulating : Reference

17/09/07 January 24th, 2008



- Based on the calibrated model
 - All trains within the theoretical timetable
 - Infrastructure unchanged
 - Modification of injection rules for line B South > North
- Evaluation criteria of reference (also used to evaluate scenarios)
 - Peak hour capacity
 - Overall delay for each line, end of main study zone
 - Mean delays + standard deviation



6. Simulation in several steps : scenarios

17/09/07 January 24th, 2008



- ☞ Modelling of the following parameters, according to the scenario
 - ☞ Infrastructure
 - ☞ Initial delay (piecewise linear distribution)
 - ☞ Timetable and dwell times
 - ☞ Rolling stock

- ☞ Visualisation on screen → check of correct modelling

- ☞ Simulation : 20 runs for each scenario, without visualisation

- ☞ Statistical analysis
 - ☞ « OT_timetablestatistics.txt » file, wasn't helpful, only the last run recorded
 - ☞ Our partner, Mr Huerlimann developed a new file with the listing of 20 runs
 - ☞ Direct use of the Excel file in a specific Excel based program



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17/09/07 January 24th, 2008



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17/09/07 January 24th, 2008



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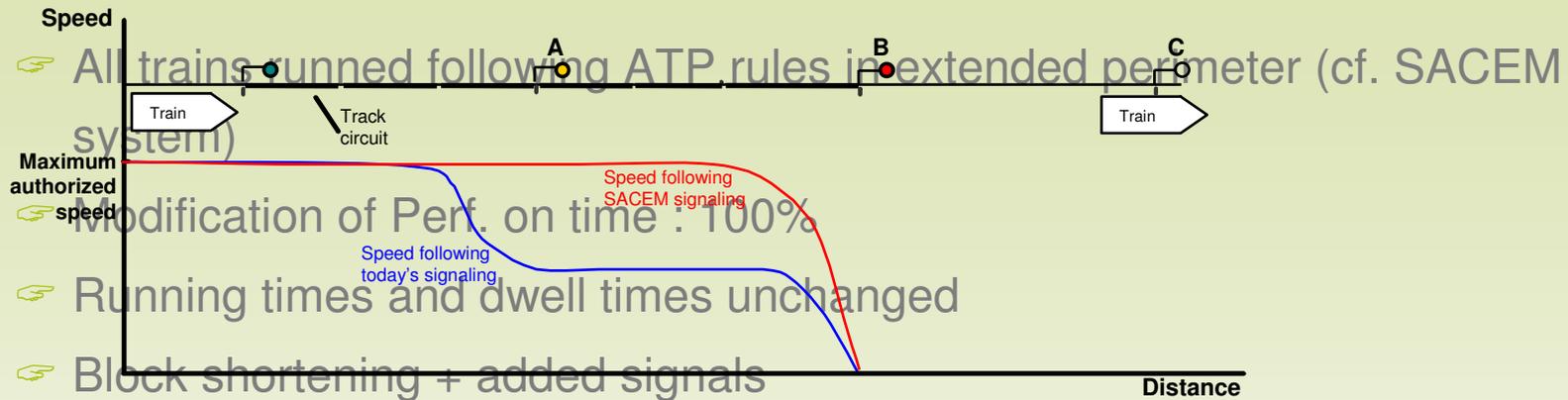


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17/09/07 January 24th, 2008



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☞ Possible improvements

- ☞ Different boarding-unboarding times according to rolling stock
- ☞ Interface with other simulation software (i.e. : Simwalk)
- ☞ Definition of crowds on platform : impact on dwell times



End ...

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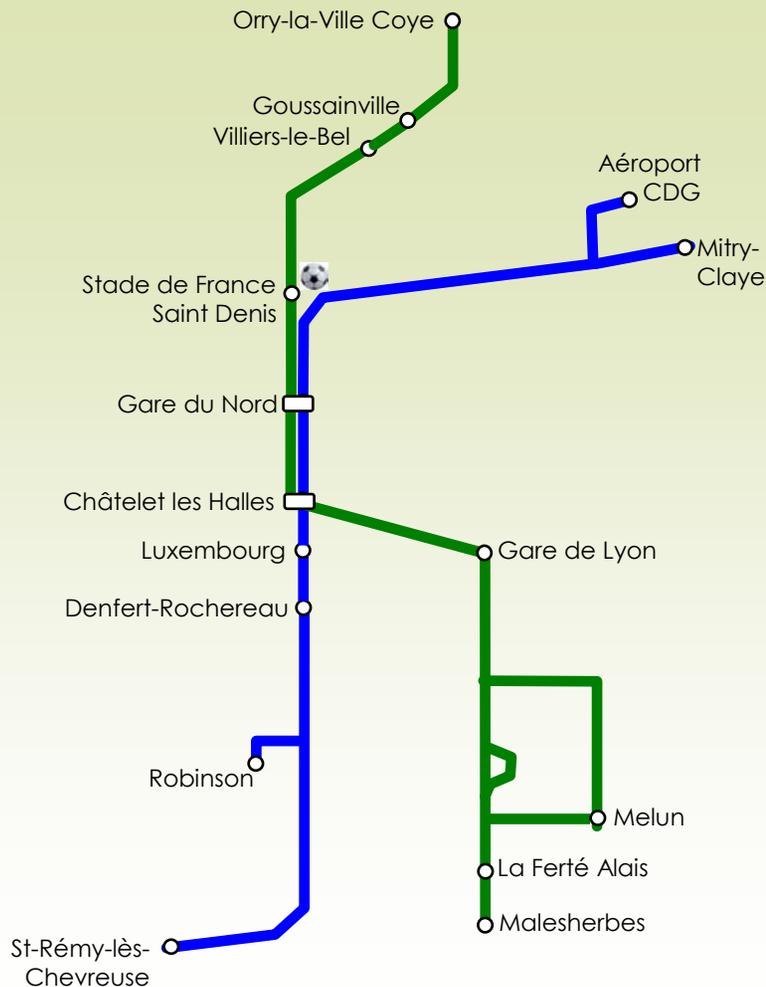
Thank you for your attention !!!

I'm available for your questions



Brief history of line RER B and RER D

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- **From 1846 : historical « ligne de Sceaux » ending first at Denfert-Rochereau, later at Luxembourg,**
- **1977 : continuation under the Seine river, until Châtelet les Halles,**
- **1981 : opening of the Châtelet – Gare du Nord tunnel**
- **1983 : junction with Roissy-Rail airport courses and the Mitry – Gare du Nord line = today's line B**

- **1987 → 1990 : trains coming from Villiers le Bel, Goussainville and Orry la Ville stopping first at Gare du Nord, extended at Châtelet les Halles (via existing tunnel)**
- **1995 : opening of the Châtelet – Gare de Lyon underground section, trains heading toward Melun, La Ferté-Alais and Malesherbes**
- **1998 : opening of Stade de France Saint-Denis station**

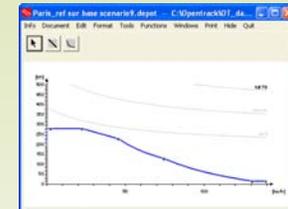


Rolling stock involved in the tunnel

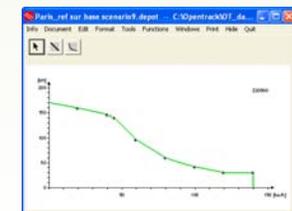
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- Date of construction : 1980-1983
- V max : 140 km/h
- Max passenger capacity : 843 p.
- Length : 104 m
- Weight : 283 T
- Concerned line : RER B
(also running on line A)

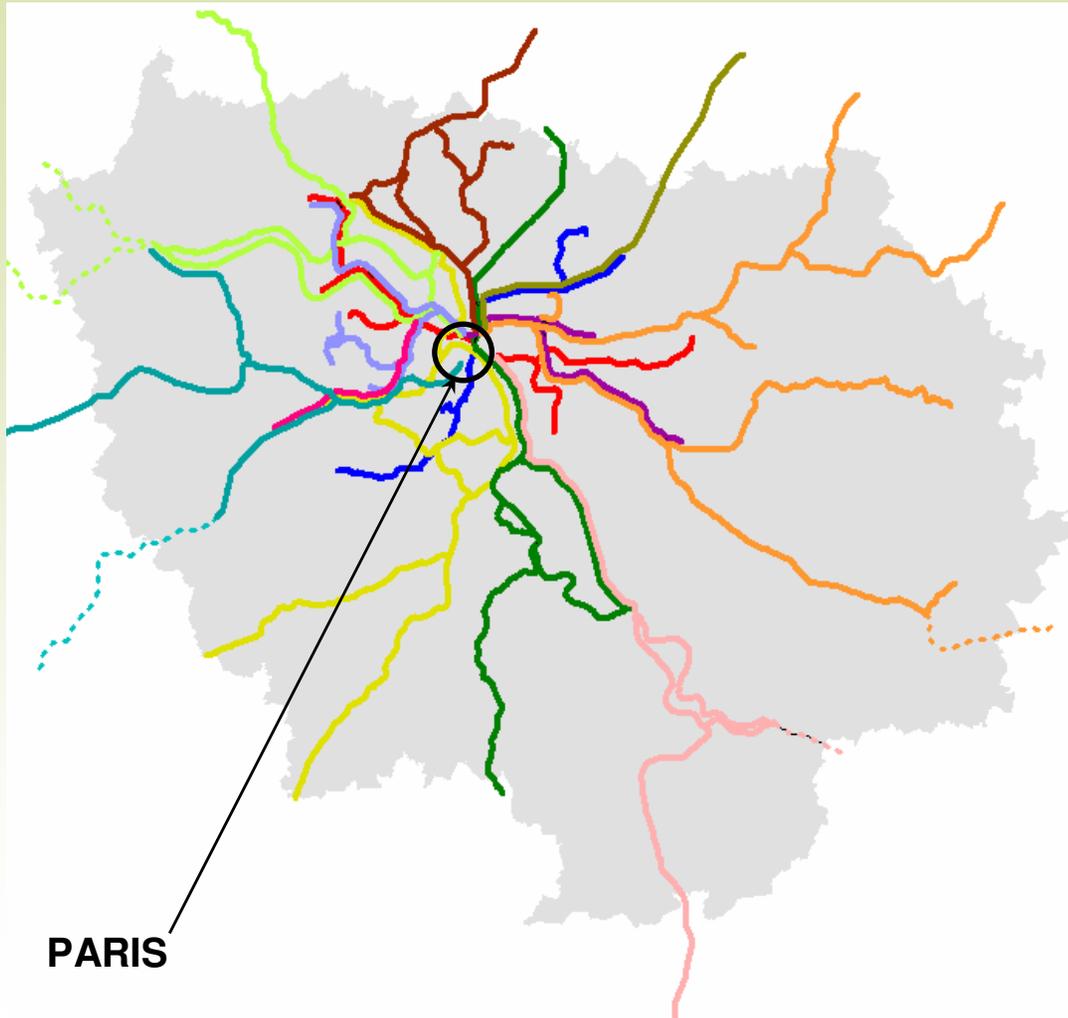


- Date of construction : 1988 - 1998
- V max : 140 km/h
- Max passenger capacity : 1413 p.
- Length : 129 m
- Weight : 381 T
- Concerned line : RER D



Ile-de-France regional rail network

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- Réseau Express Régional
- Strong and identified network
- Paris underground cross-over
- 2 operators : RATP + SNCF



- SNCF operation (Transilien)
- Basic commuter lines
- Terminus in 6 main stations
- Possible shared trunks with RER lines



7. Other scenarios – selected list

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☞ Basic scenarios

- ☞ Equal RS performances for both lines
- ☞ Modification of line D headway
- ☞ 2nd tunnel between surrounding stations
- ☞ Modification of injection following improvements outside perimeter

☞ Combined scenarios



What is Egis Rail ?

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Europe's major financial institution, N°1 French financial group



A French consulting, engineering and operating firm, dedicated to development infrastructures



Rail and transit consultants and engineers, formerly named SEMALY, created in 1968

Covering all types of transport projects

- Metro
- Light Rail Transit
- Conventional Rail
- High Speed Lines

For the benefit of

- Ministries of Transport
- Regional or City Authorities
- Operators
- Private Consortia, etc...



Egis Rail ? Range of services

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- Planning studies, Consultancy and Audits
- Design
- Procurement assistance
- Construction management and supervision
- Manufacturing control
- Testing and commissioning
- Maintenance management



Egis Rail ? References



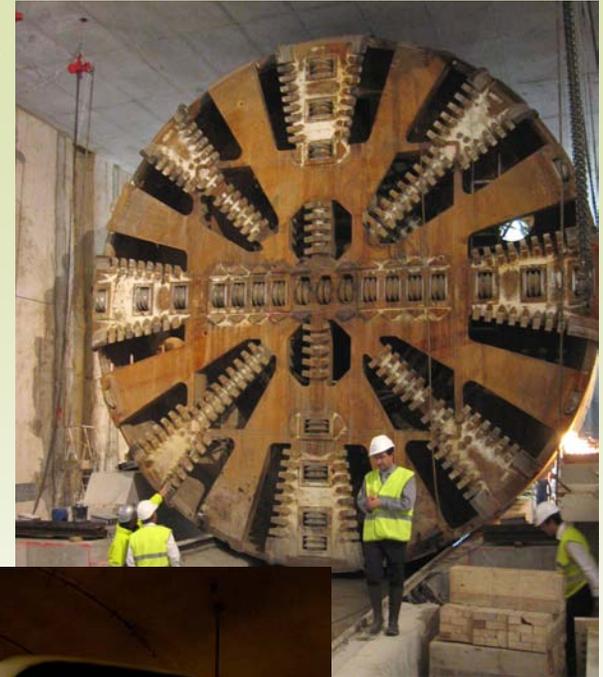
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METRO



LYON : whole network
(line D, fully automated)

Tunnel boring
machine



MARSEILLES
Extension of the network



Egis Rail ? References



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☞ LIGHT RAIL TRANSIT



DUBLIN: Technical Design
& Construction Management



KRAKOW : design assistance
and construction supervision



OPORTO: integrated engineering
within a private Consortium

