The French revolution of train control

Jared Haube for Train Control

France's national railway network, *Réseau Ferré de France* (RFF) announced a new €15 billion Railway Investment Plan last year in September to upgrade infrastructure, increase capacity and modernise the nation's rail technology.

Transport Minister Frédéric Cuvillier had requested the plan after an audit was conducted by the École Polytechnique Fédérale de Lausanne (Swiss Federal Institute of Technology in Lausanne).

At the last Train Control and Management Systems conference, I spoke to **Sylvie Lesueur, former Deputy Manager for the Signalling and Rail Operations Centre (ROC) Department,** to discuss some of the strategies, technologies and developments involved in improving railway capacity and efficiency.

ETCS

One of the core European challenges facing the network relates to the rollout of ETCS; small parts of the network had ETCS Level 2 installed in 2009, and the wayside equipment will be in revenue service by the end of 2013. A train with on-board equipment is slated to run in 2014. Large sections of the network, however, still maintain original systems.

"From a signalling perspective, the main issue is interoperability on high-speed railway and fret corridor lines. We already have track-to-train transmission implemented into our High Speed Railway Lines," Sylvie noted.

There are two track-to-train transmission (Transmission Voie-Machine – TVM) versions in use:

1. The TVM-300, which was developed in the 1970s as part of the *Train à Grande Vitesse* (TGV – high speed train). TGV trains operate on dedicated railway lines labelled *Lignes à Grande Vitesse (LGV)* and exceed 220 kmph. Whilst travelling at such speeds, drivers cannot accurately identify colour-light based railway signals positioned track-side. Signalling information is directly transmitted to the train and displayed within the train controls.

2. The TVM-430, established in the 1980s. This system transmits more information than conventional signalling enables, such as gradient profiles and the conditions of nearby signalling blocks.

Not only does interoperability play a crucial role to determining the effectiveness and opportunity for ETCS network rollouts, but also the fact that these systems actually work very efficiently for the railway.

"It's a lot easier to introduce ETCS to countries like Spain, which had its first high speed railway line established in 1992 from Madrid to Seville.

"In France, we opened our High Speed Lines in 1981 starting with service between Paris and Lyon on the LGV Sud-Est. ETCS didn't exist and the French railway had its own standard," Sylvie said.

ERTMS

The French network accounts for more than 2000 km of high speed railway lines. The LGV Sud-Est to which Sylvie refers, proved commercially successful upon its inception and led to southward expansion with the LGV Rhône-Alpes and the Mediterranean, as well as towards the west with LGV Atlantique, north with LGV Nord, and east with LGV Est Européenne (LGV EE).

Since December 2011 the LGV Rhin Rhône has been in revenue service with trains running at 320 kmph, equal to those on the LGV EE.

European Rail Traffic Management System (ERTMS) Level 2 will be in revenue service on all of the new high speed lines in France that are under construction in PPP (Public-Private-Partnership):

1. LGV BPL (Bretagne Pays de Loire) – the high speed line in the west of France. This is an extension of the Atlantique high speed line and will be developed between Le Mans and Rennes.

2. LGV SEA (Sud-Europe Atlantique) – another extension of the Atlantique high speed line. It will take place between Tours and Bordeaux.

The first line that will put ERTMS Level 2 in revenue service is the LGV EE – Ligne à Grande Vitesse Est Européen (East European High Speed Line) – from Paris to Baudrecourt (southeast of Metz in Lorraine).

LGV EE has been in revenue service since 2007 and estimated completion of the ERTMS rollout will be at the end of 2013 for wayside equipment. It will extend to Strasbourg in Alsace in 2016 (only a few kilometres from the border with Germany).

Rail Operations Centres

Sylvie spent seven years working for RFF, with two and a half years dedicated to the Safety Authorisation Department. She managed a team of eight that worked on building safety cases to approve lines for revenue service.

She transferred to the Signalling Department as the Deputy Manager in charge of a new Rail Operations Centre (ROC) project.

"We had to build a business case to support the project's feasibility. That involved extensive review of all signal boxes on the network. The idea was to consolidate the command of all signal boxes into 16 ROCs to improve train operation management. In 2007 we had 75 million Euros per year to renew signal boxes." she said.

Bourgogne Franche Comté Rail Operation Center in Dijon, Burgundy

After embarking on the ROC project, investment was raised to 340 million Euros in 2013 (with intentions to reach a target of 400 million). The increased scope of this project meant ensuring that there was enough manpower to support the required amount of work.

France currently has 1500 signal boxes in operation across 14000 km of the main network (representing 90% of the traffic). The mixture of signalling technology in France reflects the impact of legacy systems that have been maintained over many years:

Mechanical signal box

Electric (push button) signal box

Computerised signal box

"The ROC project in which I was involved was part of a current initiative to consolidate these 1500 operating locations (signal boxes) into 16 rail operations centres, in order to have a more efficient and economical organisation for managing train movements. It started with an issue of ageing signal equipment and led to a train traffic management project," Sylvie said.

RFF recently put in service a new ROC in the Lorraine region at Pagny-sur-Moselle and one in the Rhône Alpes region in Lyon (both in 2010). In a ROC, each traffic operator commands a traffic section that comprises up to a dozen signal boxes.

RFF expects 60% of the project to be rolled out by 2032. At this time 14 rail operations centres will be completed with a total of 148 traffic section (out of 256) remote controlled from these ROCs. Development of all 16 rail operations centres will be completed by 2050.

Be sure to check out her full presentation from the last event below:

www.traincontrol.com.au Call +61 (2) 9229 1000 Email: registration@iqpc.com.au

FRENCH INFRASTRUCTURE &
TMS : THE RAIL OPERATION CENTER PROJECT

BY SYLVIE LESUEUR

THURSDAY 13TH OF FEBRUARY 2014 IQPC CONFERENCE TRAIN CONTROL AND MANAGEMENT SYSTEMS 2014.

CONTENTS

1. A bit of french railway history,

2. French Network Organization,

3. Global overview of the French Network,

4. RFF ambition,

5. TMS : The ROC project (CCR in french),

6. ROC example in Rhône Alpes,

7. ROC road map to 2032

1. A BIT OF FRENCH RAILWAY HISTORY

- Before 1938 :
    - Private companies : Compagnie du Nord, Paris-Lyon-Mediterranée, Paris-Orléans-Midi, Compagnie de l'Est,
    - Public companies : Réseau Ouest-Etat, Réseau Alsace Loraine.
- 1938 : SNCF is born, Société Nationale des Chemins de Fer français.
- 1997 : RFF is born.
- 2013 : it's not working efficiently.
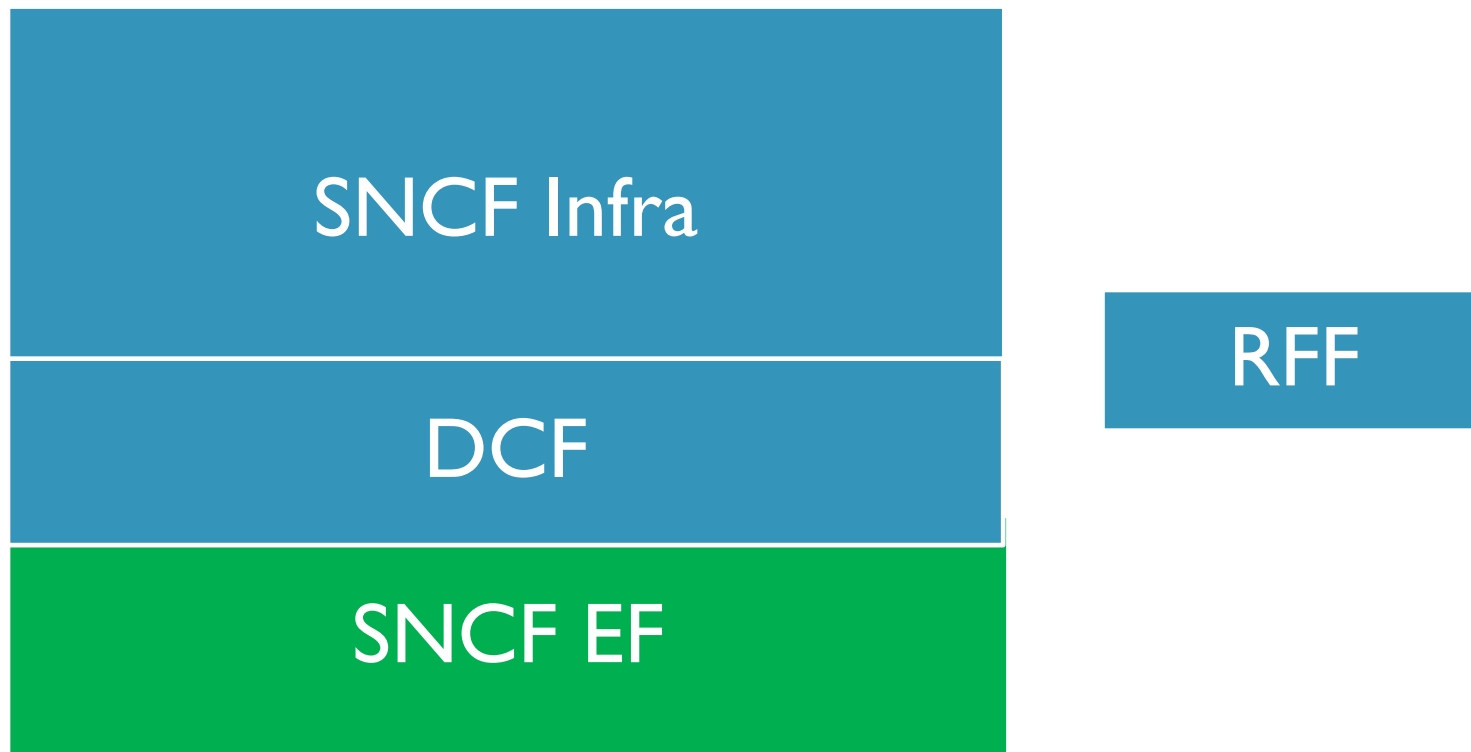- 2015 : only one entity for the Infrastructure Manager.
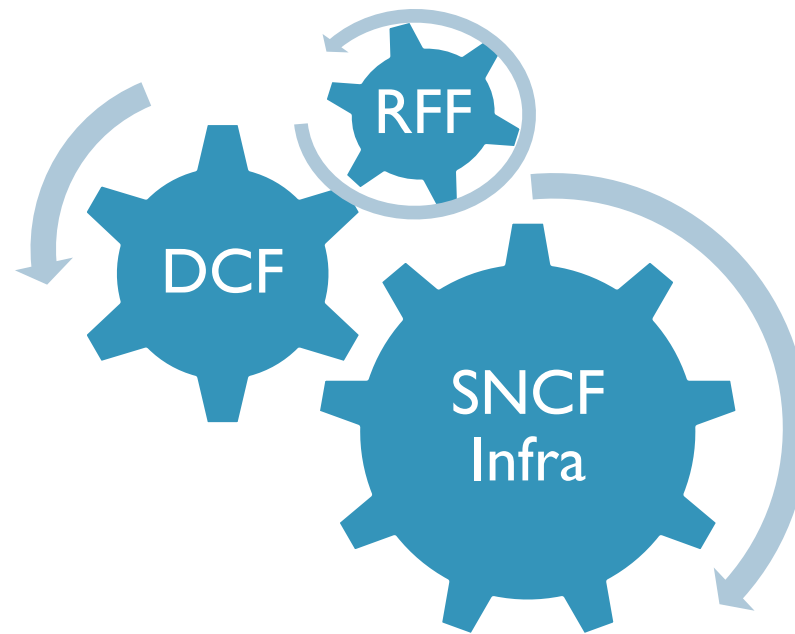
2. FRENCH NETWORK ORGANIZATION : BEFORE 1997

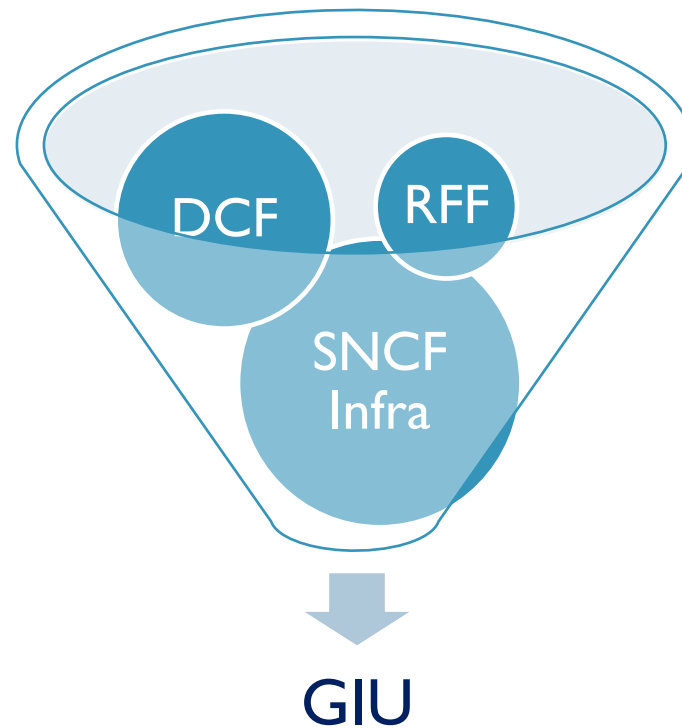## SNCF

2. FRENCH NETWORK ORGANIZATION IN 1997

SNCF Infra

RFF

Infrastructure Manager

SNCF EF

Train Operating Company

2. FRENCH NETWORK ORGANIZATION : IN 2009

SNCF Infra

DCF

SNCF EF

RFF

2. FRENCH NETWORK ORGANIZATION : IN 2013

2. FRENCH NETWORK ORGANIZATION : IN 2015

3. GLOBAL OVERVIEW OF THE FRENCH NETWORK

As the second largest European railway network and the second largest property owner in France, RFF maintains and operates a strategic asset portfolio with great potential.

- **30 000 kilometres of mainline (19 000 miles)**

- **15 000 freight and passenger trains travel every single day**

3. GLOBAL OVERVIEW OF THE FRENCH NETWORK

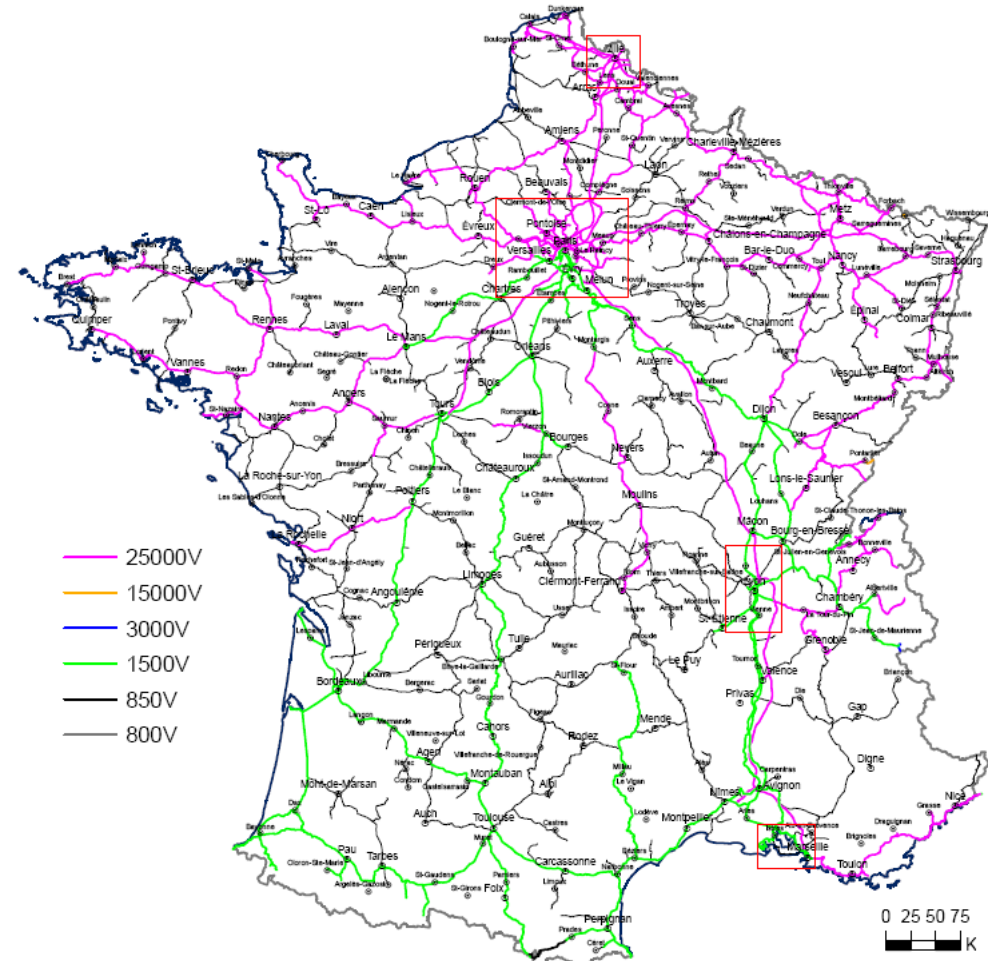- **1.900 km (1200 miles) of High Speed Lines,**

- **13.000 km (8000 miles)of one track rail,**

- **18.000 level crossing,**

- **1.700 tunnels,**

- **31.000 bridges.**

3. GLOBAL OVERVIEW OF THE FRENCH NETWORK

- **15 000 km (9000 miles) of electrified lines,**
- **2500 signal boxes.**

—	25000V
—	15000V
—	3000V
—	1500V
—	850V
—	800V

0 25 50 75

4. RFF AMBITION

- **In 2010, the French Network is mostly under used :**
  - 15.000 freight and passenger trains running per day,
  - But 80 % of the traffic is concentrated only on the third of the network.
  - And 10 % of the traffic on half of the network.
 - 5.000 km (3000 miles) of lines without traffic (no traffic on 15 % of the network).
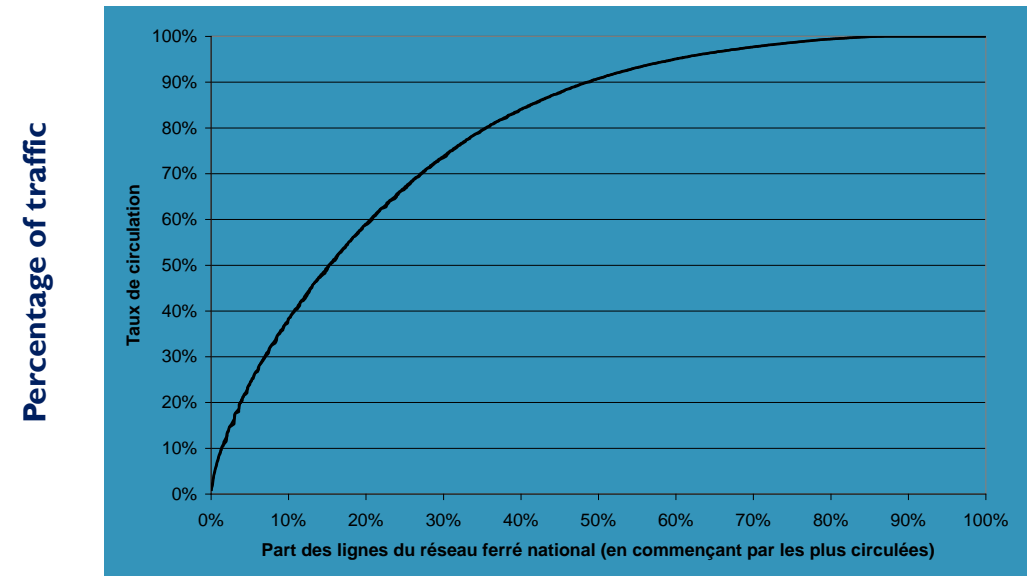
Percentage of french railway network lines (starting with the one with bigger traffic)

4. RFF AMBITION

Furthermore, taking into account the age of the network and the traffic decline since the 70's (in favor of individual cars and freight road transportation), the situation has worsened :

- Ageing infrastructure imposing to put in place many slowdown on traffic sections.

- Between 1980 and 2000 ; getting behind renewing the infrastrucuture, especially the track.

An independent audit has been conducted between 2004-2005 by EPFL (Ecole Polytechnique Fédérale de Lausanne in Switzerland).
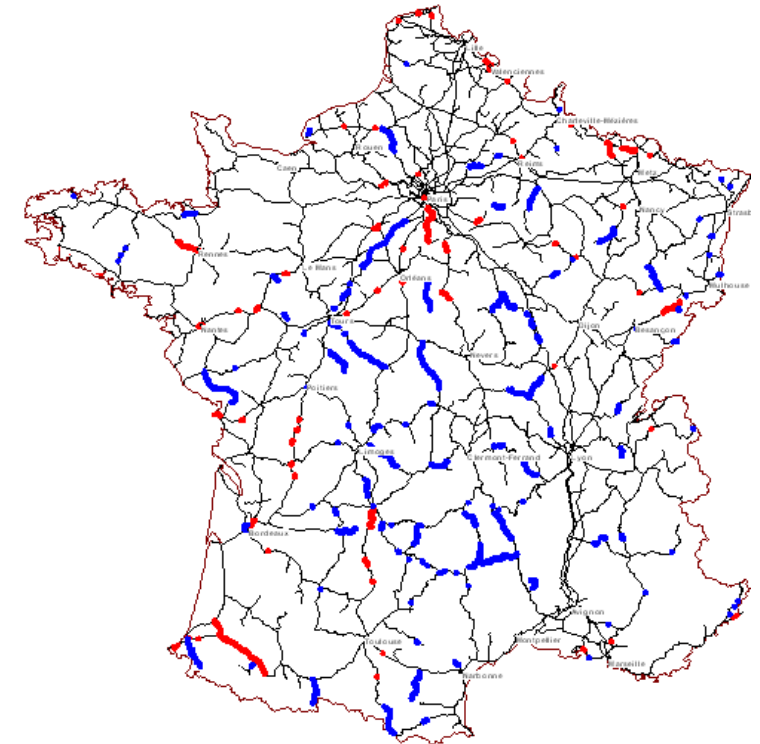
Slowdown on the French Network
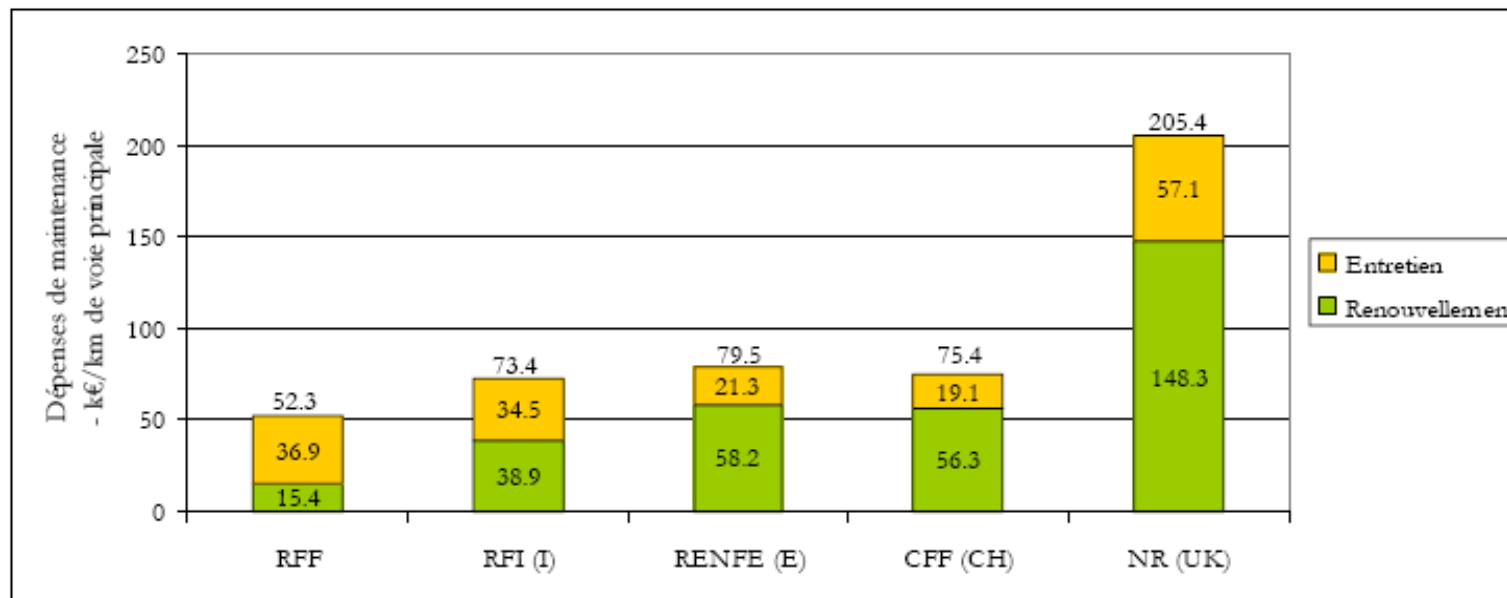
4. RFF AMBITION

Main conclusion of the audit :

- The french network is very stretched out and not jammed,

- A singularity : most of the network is circulated by a small number of trains,

- The shape of the railway network is satisfactory for the most circulated tracks,

- Safety is ensured on all of the railway network,

- More than half of the track is ageing and the total of signalisation devices on the network are ageing (except on High Speed Line),

- Maintenance spending is double renewal spendings, a situation opposite to most networks in Europe.

4. RFF AMBITION

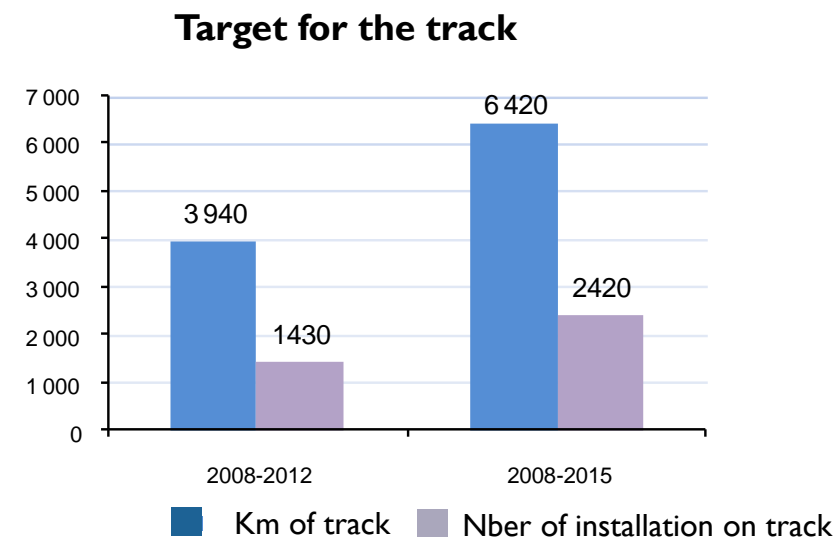- Comparaison with other European Networks :

4. RFF AMBITION

- **Starting from this observation and the audit recommandations a policy of network renovation has been conducted, especially for track and signalisation.**

- *Renovation of the network is a national stake and a priority for RFF :*
  - *Between 2008-2012, RFF has renewed 3940 km of track and 1430 signalisation installations on track (7,3 Mds €).*

Target for the track

	2008-2012	2008-2015
Km of track	3 940	6 420
Nber of installation on track	1430	2420

■ Km of track   ■ Nber of installation on track

4. RFF AMBITION

- *The target for 2008-2015 is 13 Mds €
  for 6420 km of track and 2 420
  signalisation installations on track.*

- *For the signalisation, the
  consequences are the idea of the
  CCR project.*

Renewing investment
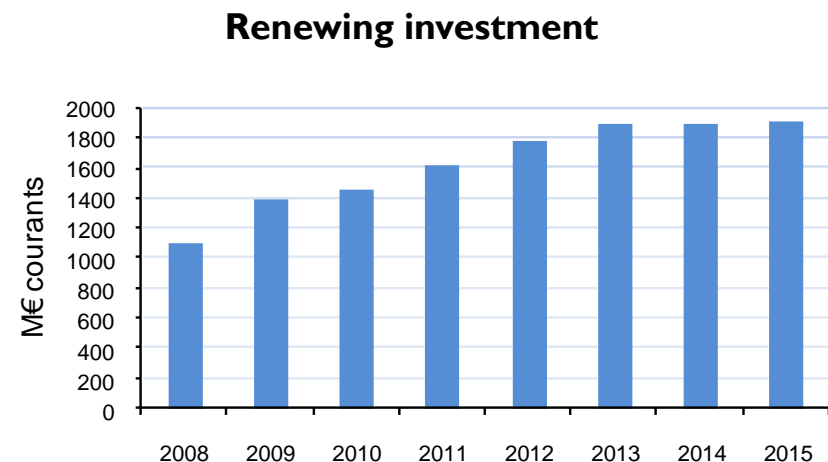
5. TMS : THE ROC PROJECT (CCR IN FRENCH)

- **EPFL audit** (2005) :

  - necessity to renew signal boxes at a higher rhythm ;

  - centralised traffic management needed through the deployment of Rail Operating Centers (CCR in french)

- RFF is face to ageing and inconsistent equipment : an increasing need in renewal.

  - Recreate the existing as needeed (end of life)?

    OR

  - Renewal at a higher rythm and in a more operating mode?

5. TMS : THE ROC PROJECT (CCR IN FRENCH)

Inventory of signal boxes

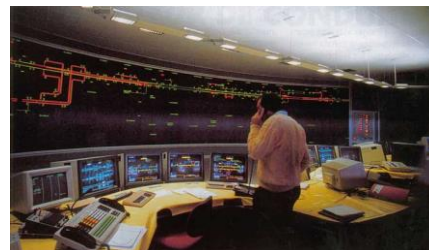Mechanical and electro mechanical

33%

Electrical

34%

Computer signal boxe

33%

Half of the fleet cannot be remote control.

Technology limiting efficiency and productivity of an operator.

Built gradualy from this fleet of scattered, hetereogenous and old signal boxes, the traffic management system lack of performance and create irregularity.

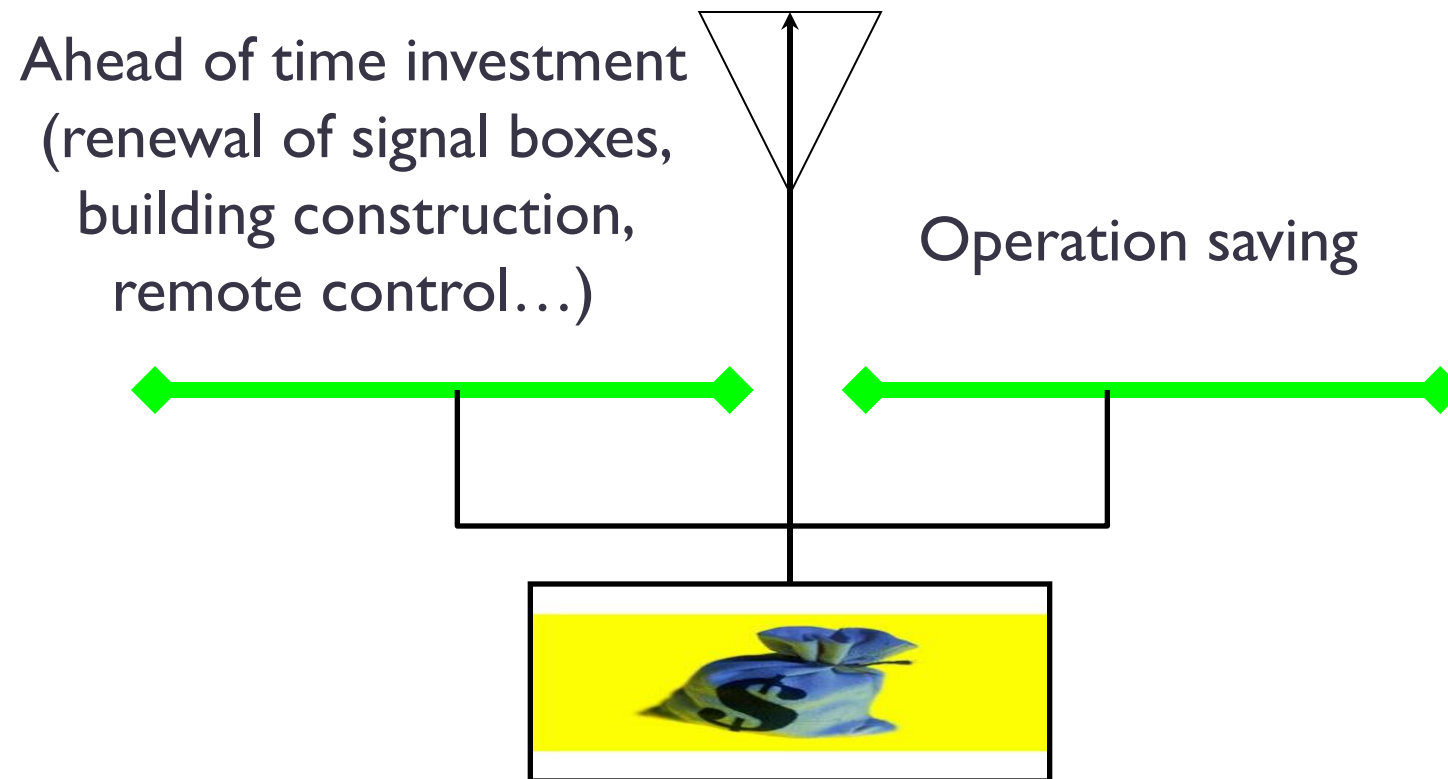In degraded mode, the traffic management system disturbes :

- The flow of bottom up information to decision center,
- Making a decision with not enough local information,
- transmission of decisions for their execution.

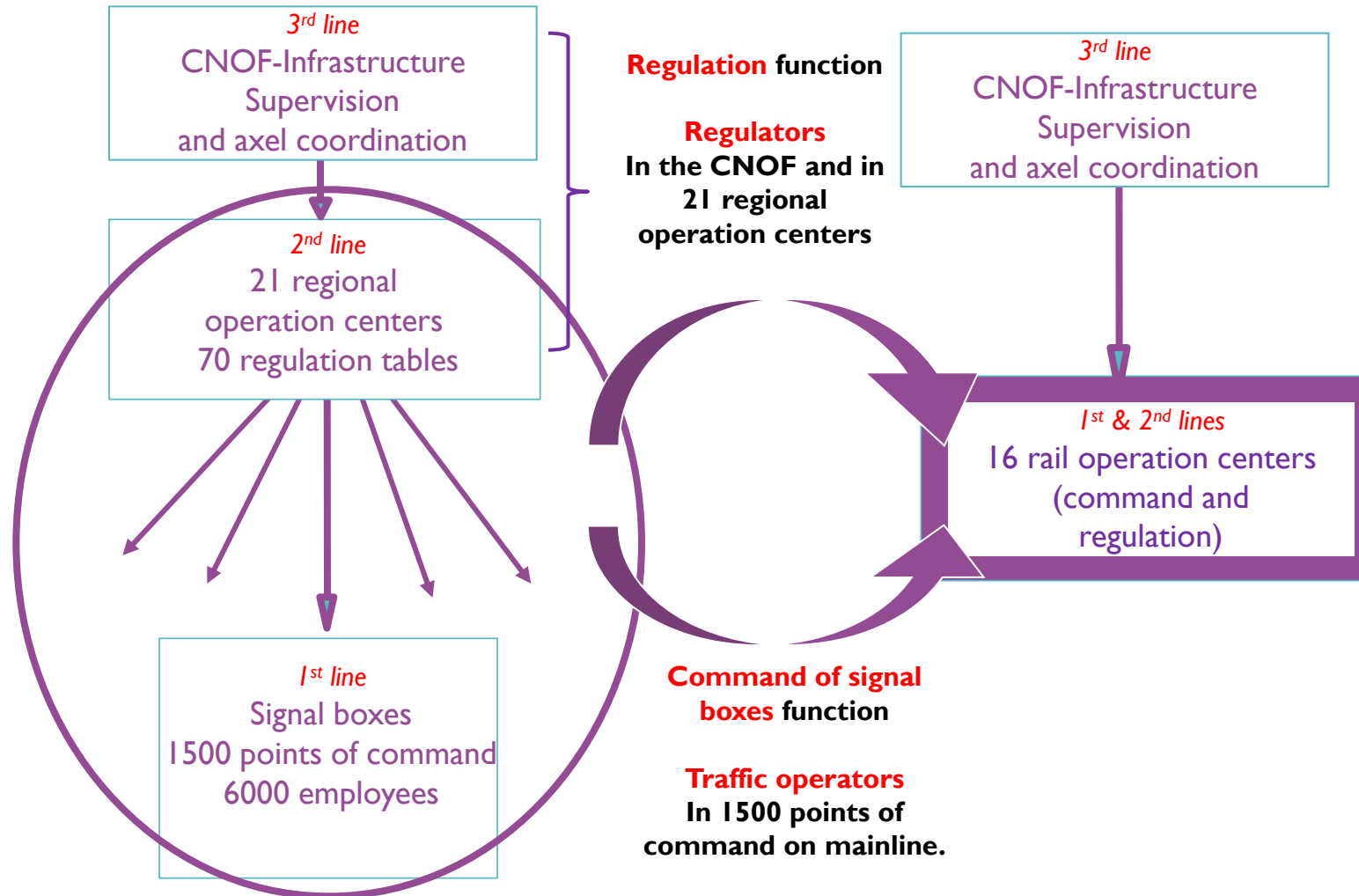# 5. TMS : THE ROC PROJECT (CCR IN FRENCH)

ROC Project =

- Take the leadership (initiative),

- Lead the investment needed for a more efficient and economical organisation of managing train movements.

5. TMS : THE ROC PROJECT (CCR IN FRENCH)

Ahead of time investment (renewal of signal boxes, building construction, remote control…)

Operation saving

➡️ vertical & horizontal organisation contraction

3rd line
CNOF-Infrastructure
Supervision
and axel coordination

Regulation function

Regulators
In the **CNOF** and in
**21 regional
operation centers**

3rd line
CNOF-Infrastructure
Supervision
and axel coordination

2nd line
21 regional
operation centers
70 regulation tables

1st & 2nd lines
16 rail operation centers
(command and
regulation)

1st line
Signal boxes
1500 points of command
6000 employees

**Command of signal
boxes** function

Traffic operators
In 1500 points of
command on mainline.

5. TMS : THE ROC PROJECT

1 500 operating locations (signal boxes) on 14000 km of the main network (with 90% of the traffic.
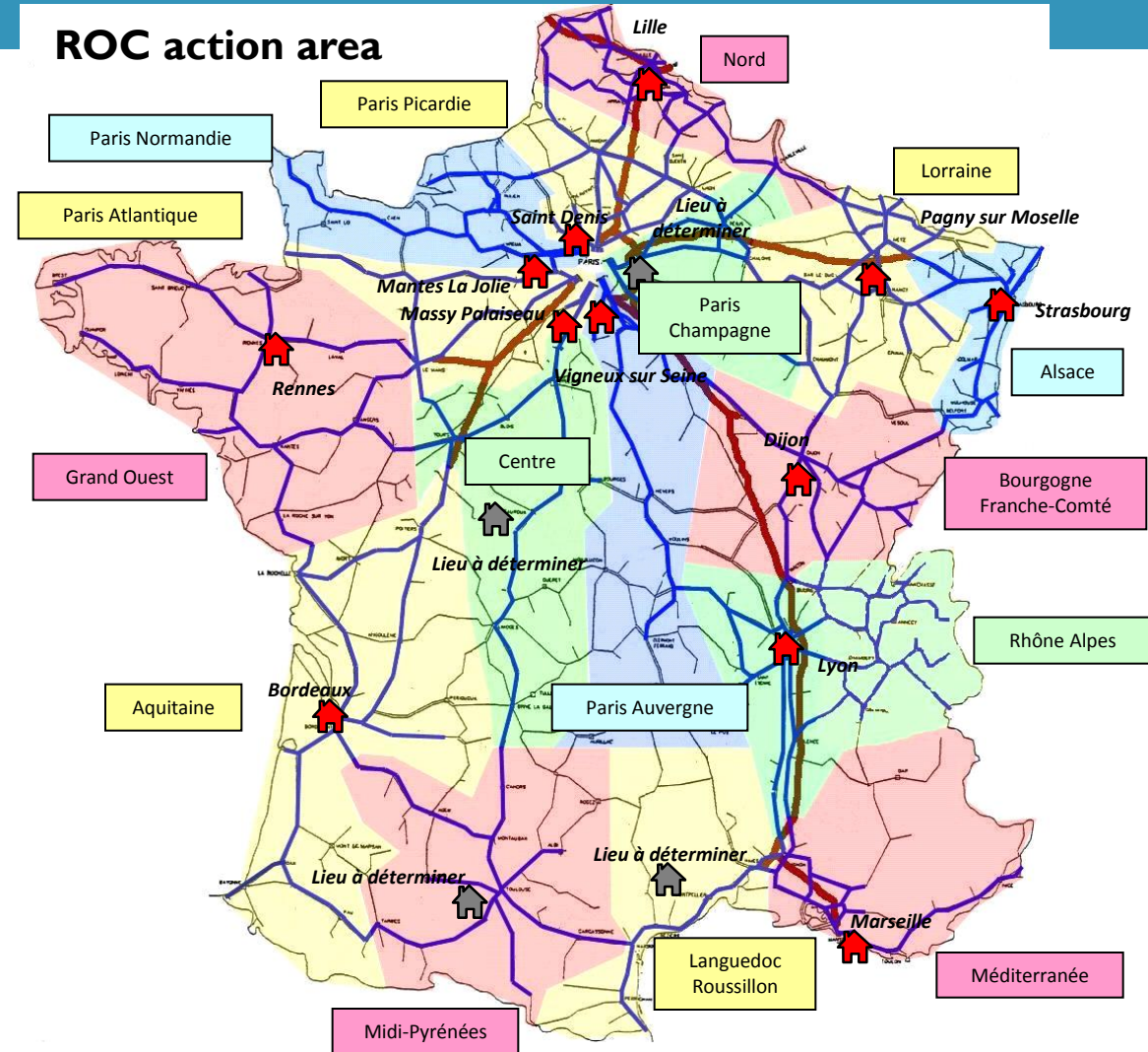
Target vision : manage this network from 16 Rail operating centers

In a CCR, each traffic operator will command a traffic section (« secteur circulation,») including up to a dozen of signal boxes.

Traffic sections are brought together in a traffic center, 1st level of regulation : traffic operators of a traffic center are supervised by a traffic & regulation manager.
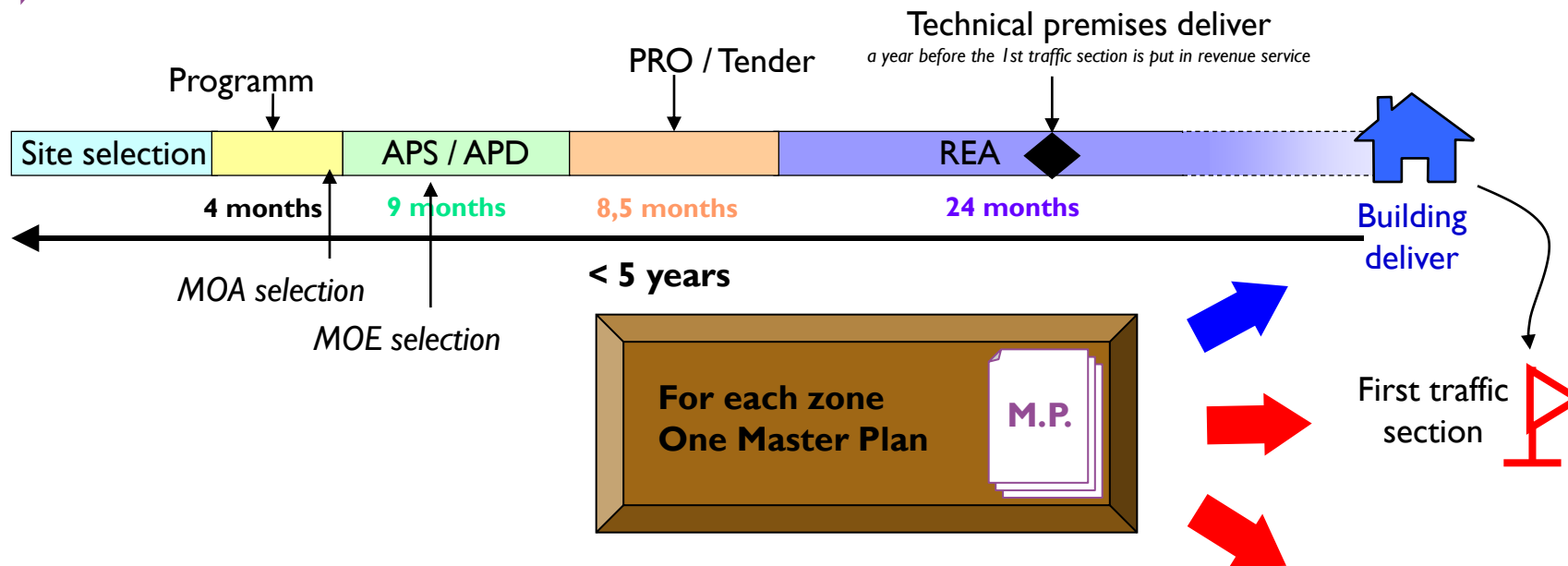
TOTAL: 16 Rail Operating Centers with 52 traffic centres and 256 traffic sections
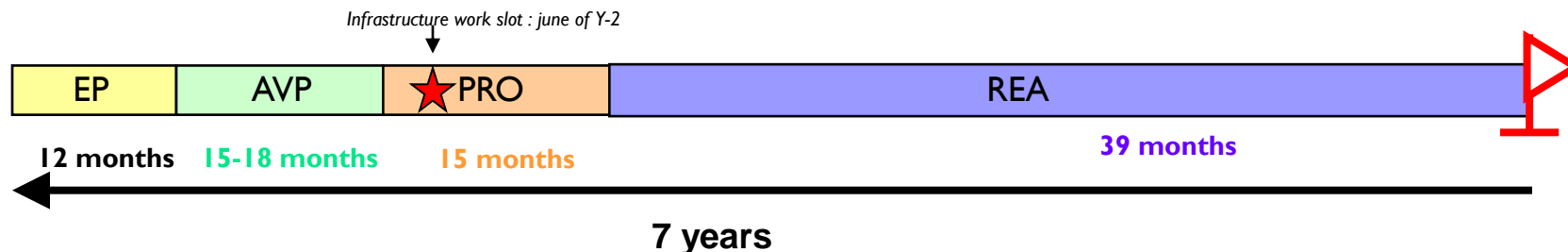
ROC action area

Lille
Nord
Paris Picardie
Paris Normandie
Lorraine
Paris Atlantique
Lieu à déterminer
Saint Denis
Pagny sur Moselle
Mantes La Jolie
Massy Palaiseau
Paris Champagne
Strasbourg
Alsace
Rennes
Vigneux sur Seine
Dijon
Grand Ouest
Centre
Bourgogne Franche-Comté
Lieu à déterminer
Rhône Alpes
Aquitaine
Bordeaux
Paris Auvergne
Lyon
Lieu à déterminer
Lieu à déterminer
Marseille
Languedoc Roussillon
Méditerranée
Midi-Pyrénées

Typical process for the construction of a ROC building

Technical premises deliver
a year before the 1st traffic section is put in revenue service

PRO / Tender

Programm

Site selection		APS / APD		REA ◆	

4 months 9 months 8,5 months 24 months

Building deliver

MOA selection

MOE selection

< 5 years

For each zone
One Master Plan M.P.

First traffic
section

Typical process for a signalling operation of a ROC traffic section

Infrastructure work slot : june of Y-2

EP	AVP	★ PRO	REA

12 months 15-18 months 15 months 39 months

7 years

25

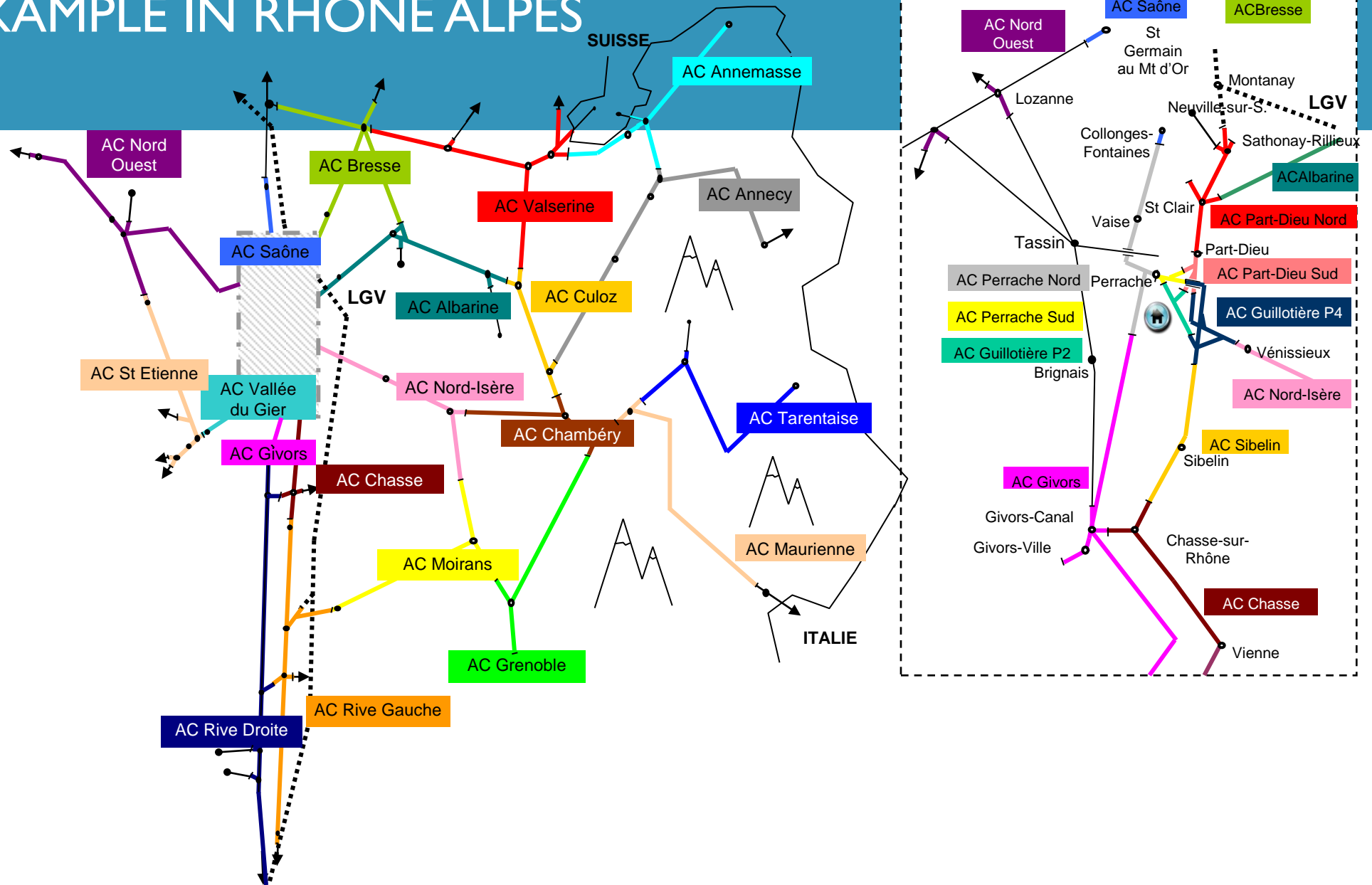# 5. TMS : THE ROC PROJECT (CCR IN FRENCH)

6. ROC EXAMPLE IN RHÔNE ALPES

- The main result of the Master Plan : the planning of each traffic section for one ROC zone.

- Here the Rhône Alpes ROC zone.

| Year of revenue service	Traffic section	Traffic center	MISTRAL (Human Interface)
2010	Part-Dieu Sud	Est-Lyonnais	Mistral CCR
2010	Part-Dieu Nord	Est-Lyonnais	
2011	Guillotière P4	Est-Lyonnais	
2014	Guillotière P2	Grand-Ouest-Lyonnais	Mistral CCR
2014	Perrache Sud	Grand-Ouest-Lyonnais	
2014	Perrache Nord	Grand-Ouest-Lyonnais	
2016	Nord Ouest	Grand-Ouest-Lyonnais	
2016	Rive-Gauche	Sud Lyonnais	Mistral CCR
2017			
2020	Chasse	Sud Lyonnais	
2022			
2029	Bresse	Alpes Nord	Mistral CCR
2029	Givors	Sud Lyonnais	
2030	Sibelin	Sud Lyonnais	
2030	Albarine	Alpes Nord	
2031	Rive-Droite	Sud Lyonnais	
2031	Valserine	Alpes Nord	
2031	Chambéry	Alpes Sud	(*)
2032	Moirans	Alpes Sud	(*)
2032	Vallée du Gier	Sud Lyonnais	

Operations room example ➡
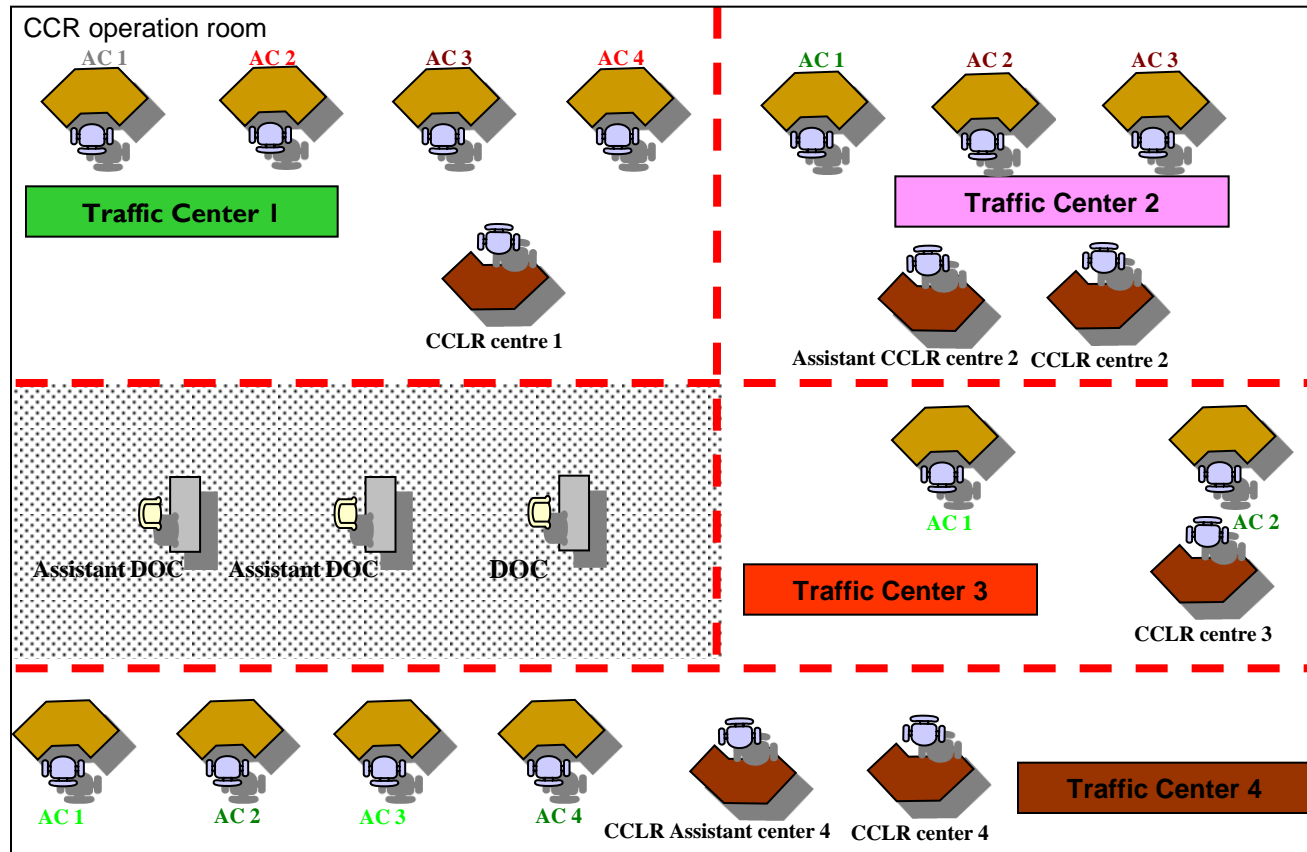
1 zone = 1 CCR operation room

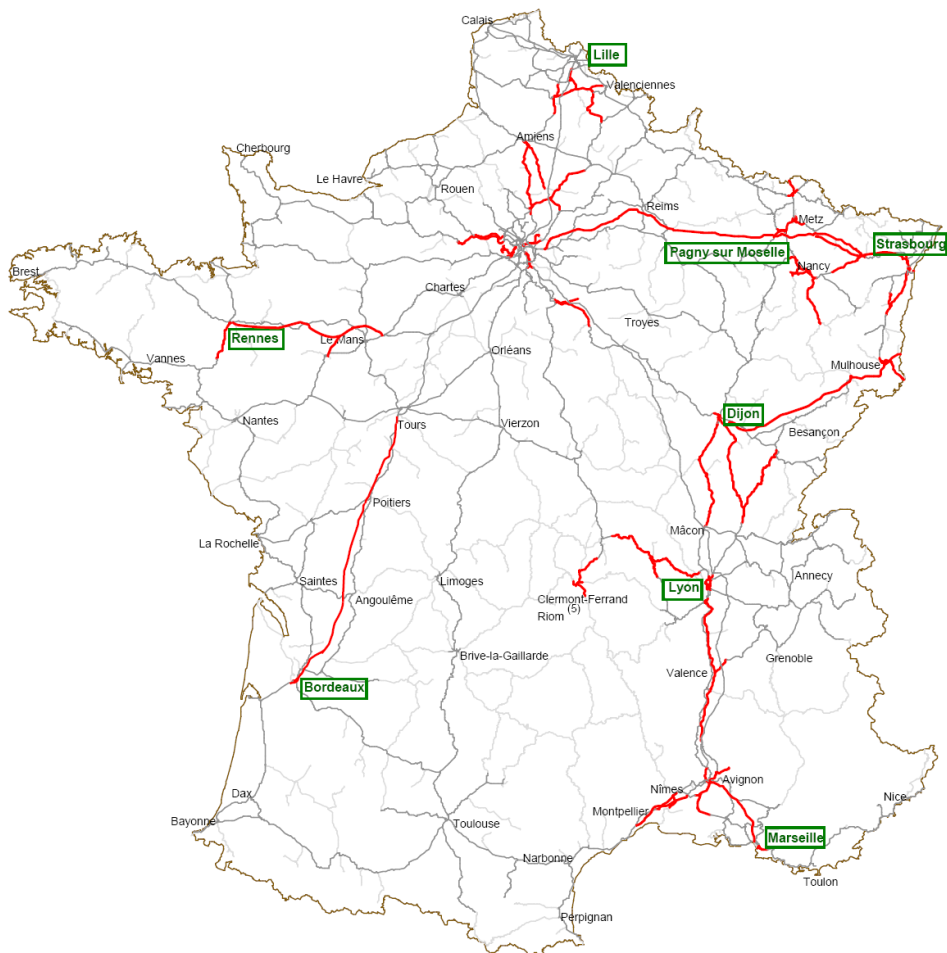1 zone CCR = 1 DOC (Head Manager)

1 zone CCR = 3 to 5 traffic centers

1 traffic center = 1 CCLR (traffic & regulation manager)

1 traffic section = 1 AC (traffic operator)
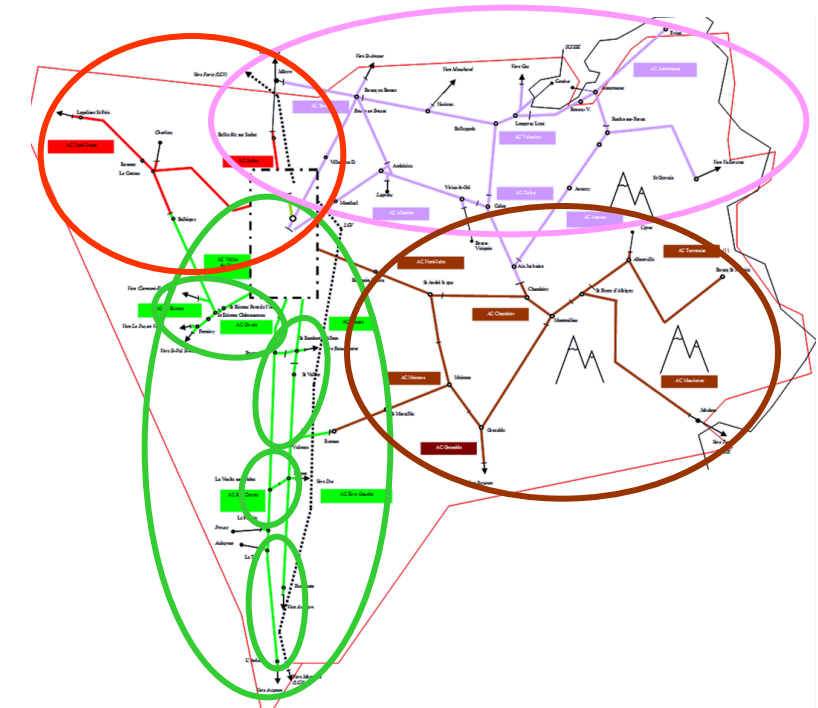
7. ROC ROAD MAP TO 2032

2020

2032

2020

2032