OCTYS CBTC Project

Département ING/STF (Transport System Unit of the Engineering division) of RATP
Open Control of Train Interchangeable & Integrated System
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OCTYS CBTC project

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2. Modernization Program for Metro
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OCTYS CBTC project : context
RATP, a national public service company

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State-owned national company created in 1949 as a public service company

One of the worldwide largest public transport network:

RER (Suburban)
- **2 lines (A & B)**
- **115 KMs (double tracks)**
- **67 Stations**
- **357 Trains**
- **446 million travels/year**

Bus & Tramway
- **351 Bus routes**
- **+ 3 Tramway lines**
- **3 868 KMs**
- **7 816 Stations**
- **4 300 Buses + 82 Trams**
- **1 031 million travels/year**

Metro
- **14+2 lines (1 to 14)**
- **202 KMs (double tracks)**
- **300 Stations**
- **689 Trains**
- **1 388 million travels/year**

All figures 2008

OCTYS CBTC project : context
CBTC Projects on existing lines

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UTO

- SAET L14 (Siemens)
  - Energy consumption optimized
    (implemented since may 2011)
  - Increase of throughput adding 4 trains
    (→ end 2012)
- SAET L1 (Siemens)
  - On revenue service since November 3rd
  - → Gradual injection of UTO trains
  - → Great Success !






STO

- OURAGAN on line 13 (Thalès)
- **OCTYS on lines 3, 5, 9 (this presentation)**

OCTYS CBTC project : context
Objectives for the Modernization/ OCTYS contribution

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Obsolescence reduction

- Replacement of older systems, tricky to maintain (components & knowledge obsolescence) ⇨ **OCTYS : new ATP/ATO + Renewal of Signalling system**

Safety improvement

- Compliance with new safety standards (CENELEC) ⇨ **OCTYS : ATP**
- Continuous speed control (incl. in manual driving mode) ⇨ **OCTYS : ATP**

Passengers capacity increase

- Headway, Regulation, Trains diagrams ⇨ **OCTYS : ATP (type 1) + ATO**

Quality of service increase

- Availability & maintainability of new systems ⇨ **OCTYS : Full redundancy ATP/ATO + Maintenance Support System (BITE ...)**
- Performance of degraded modes management
- Passenger exchange control (Platforms screen doors) ⇨ **OCTYS : Ability to be interfaced**

Operation Costs reduction

- Reduction of staff in terminus (centralized OCC)
- Less staff for line operation (when in driverless mode)
- Less trains (thanks to commercial speed improvement) ⇨ **OCTYS :ATO**
- Energy savings (with dedicated driving profiles in ATO mode) ⇨ **OCTYS :ATO**

OCTYS CBTC project : context
Network modernization Master Schedule

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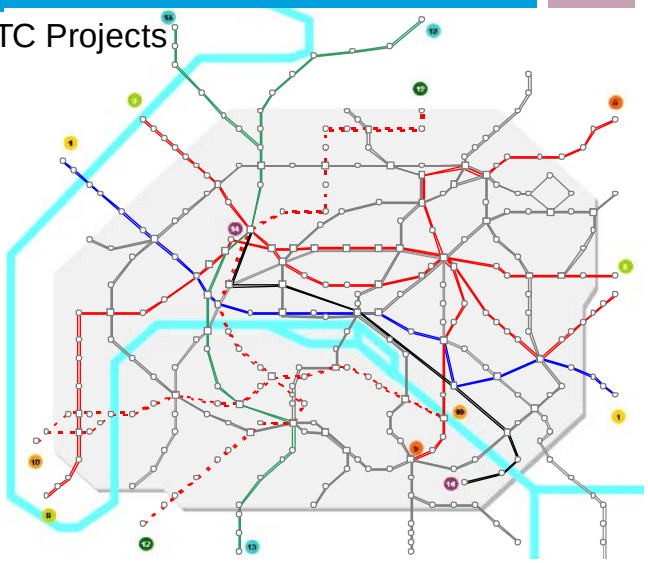
RATP current CBTC Projects



- **UTO existing (SAET L14)**
- **UTO on progress (SAET L1)**
- **STO on progress (OUR L13)**
- **STO on progress (OCTYS L3, 5 & 9)**
- **STO contracted (OCTYS L10 & 12)**
- **CBTC projected (all other M° lines)**

OCTYS CBTC project
Zoom on lines 3, 5 and 9

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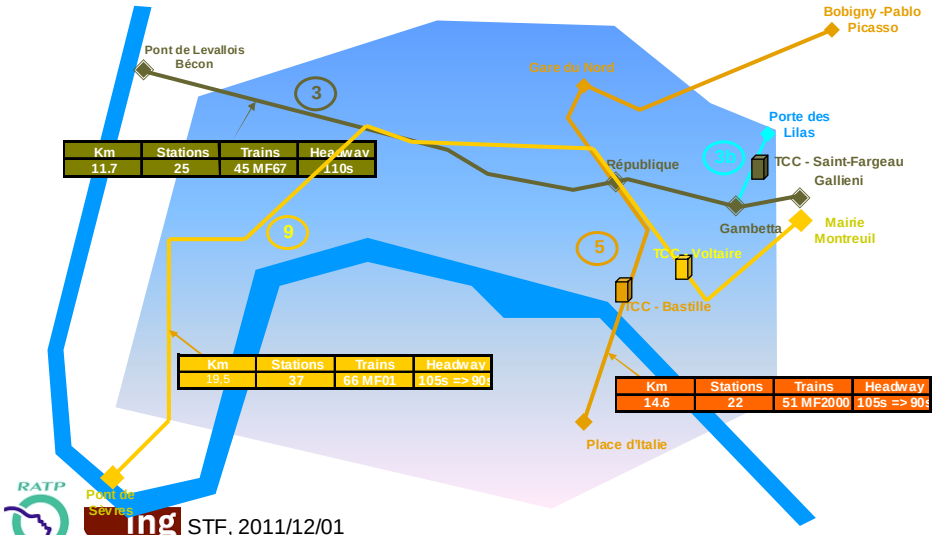

OCTYS CBTC project : Interchangeability
Concept of Interchangeability

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- **Ensure competitive procurement of interoperable CBTC/OCTYS systems for:**
  - other lines
  - line extensions
  - rolling stock retrofit or renewal
  - upgrade of obsolescent pieces of equipment
  - equipment evolutions
- **Establish design and operational standards for CBTC/OCTYS implemented by RATP**

OCTYS CBTC project : Interchangeability
Concept of Interchangeability

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OCTYS is a program for renewal of Train Control Systems (CBTC):
based on the Interchangeability Concept applied to CBTC systems
for metro lines to be renewed in STO mode

OCTYS = Open Control of Trains, Interchangeable & Integrated System
i.e.: Interchangeable CBTC

OCTYS Contract signed in 2004 with 3 suppliers (ANSALDO, AREVA & SIEMENS), for 5 lines to be revamped, in parallel with:
OCC modernization program
Rolling stock retrofit or renewal program
Signalling and Interlocking modernization program

OCTYS CBTC project
Technical features

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A generic system :

● **Features :**	● LIGNE 3	● LIGNE 5 , 9
☞ **Reduced headway**	☞ no (110s)	☞ reduction by 15%
☞ **Optional equipments**		
Cab-signal	☐	☑ new RS
Simplified wayside signalling	☐	☑
Wayside signalling cancellation	☐	☑
Train Detection reliability	☑	☑
Platform Screen Doors	☐	☑ ability
Guideway Intrusion Detection	☐	☐
Full redundancy	☑	☑
☞ **Driving modes**		
ATO mode	☑	☑
Manual mode (full train protection)	☑	☑
Automated Turnback Mode	☐	☑ ability
Civil Speed Protection Mode	☑	☑

OCTYS CBTC project: Interchangeability
General standardized CBTC architecture

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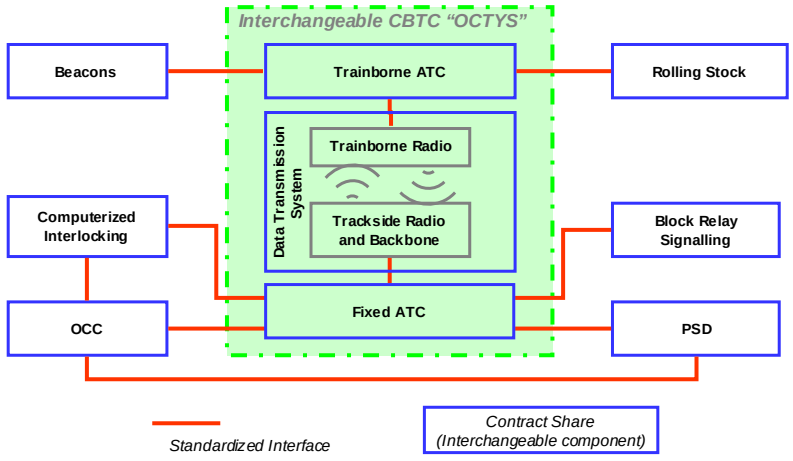

RATP ing STF, 2011/12/01

OCTYS CBTC project : Procurement
Contract sharing for CBTC system

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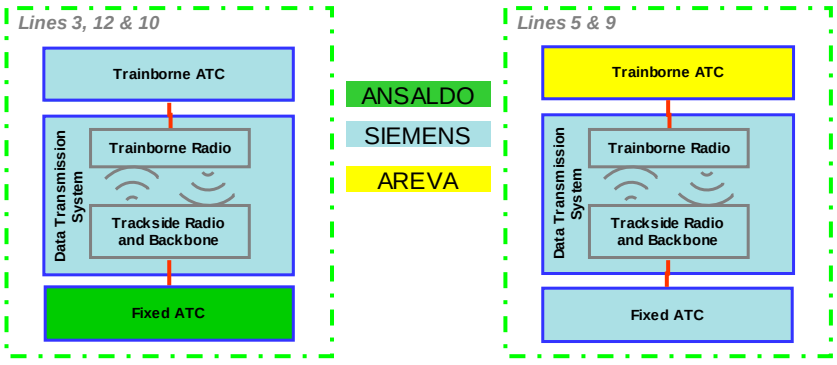

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OCTYS CBTC project : Design documentation
Interchangeability Baseline documentation

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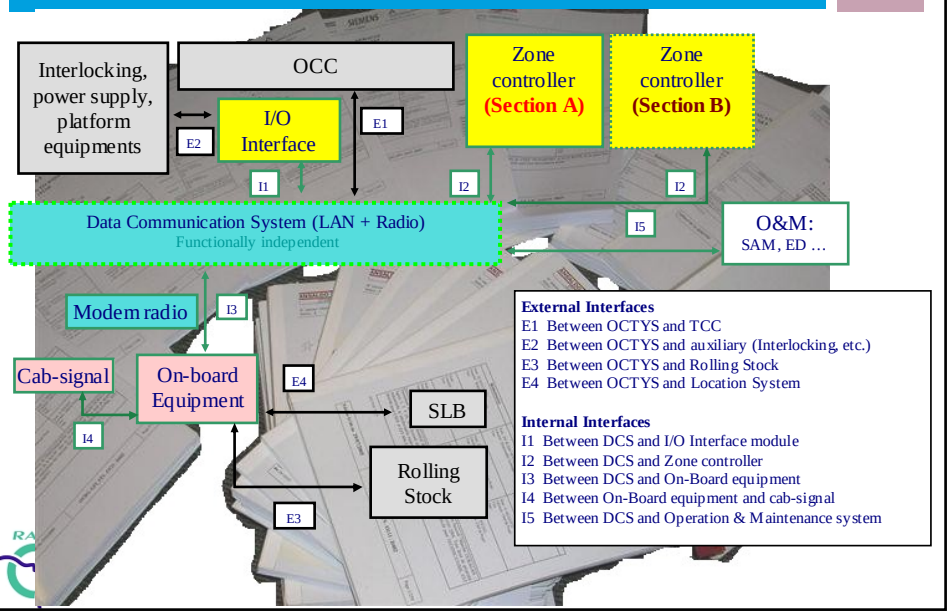

OCTYS CBTC project
BAQUS Validation Test bench “hardware-in-the-loop”

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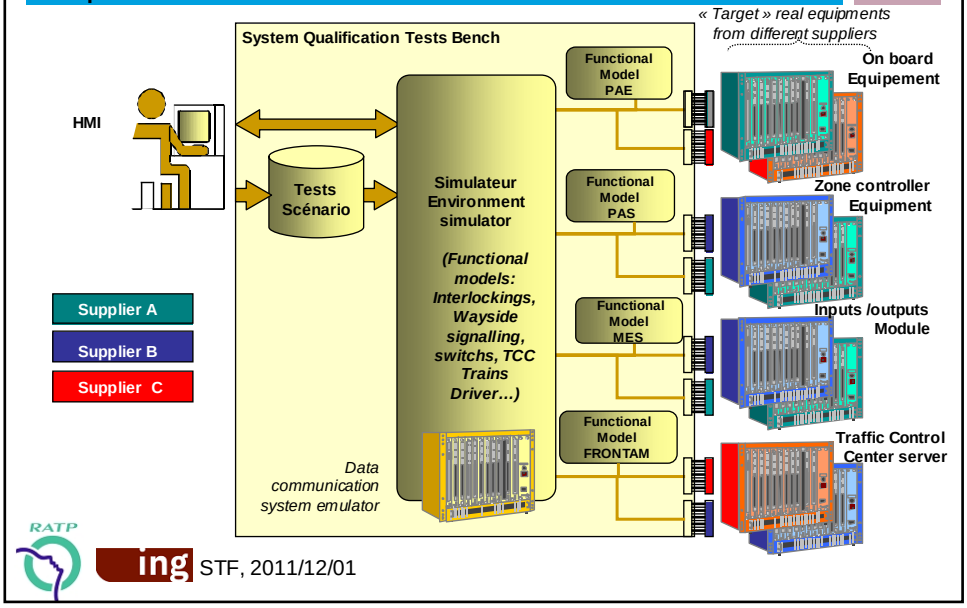

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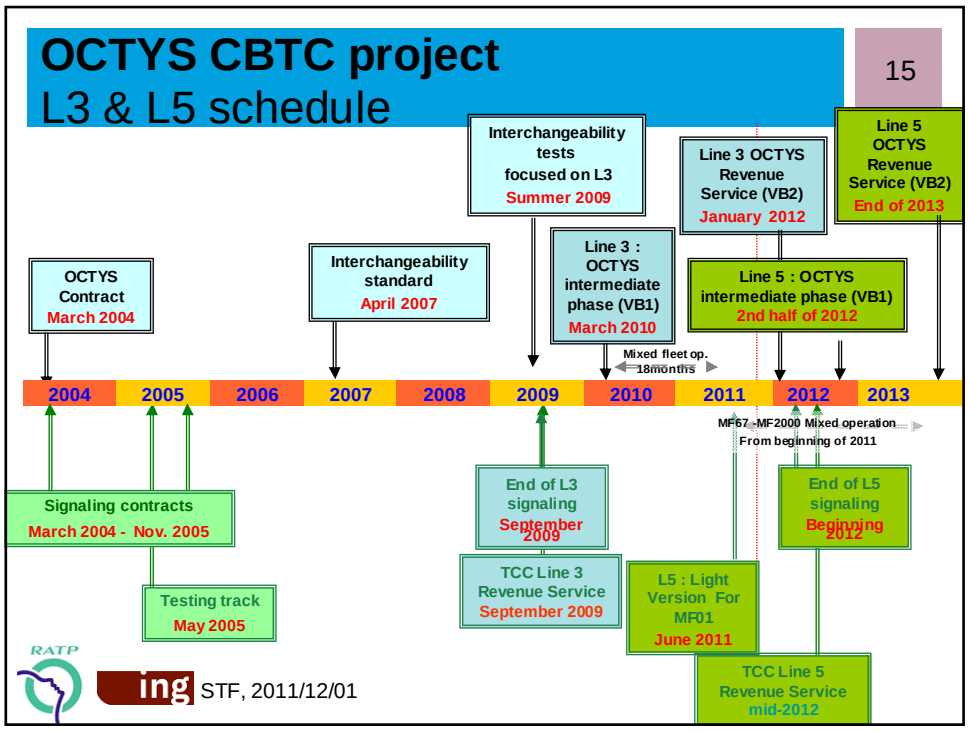
OCTYS CBTC project
L3 & L5 schedule
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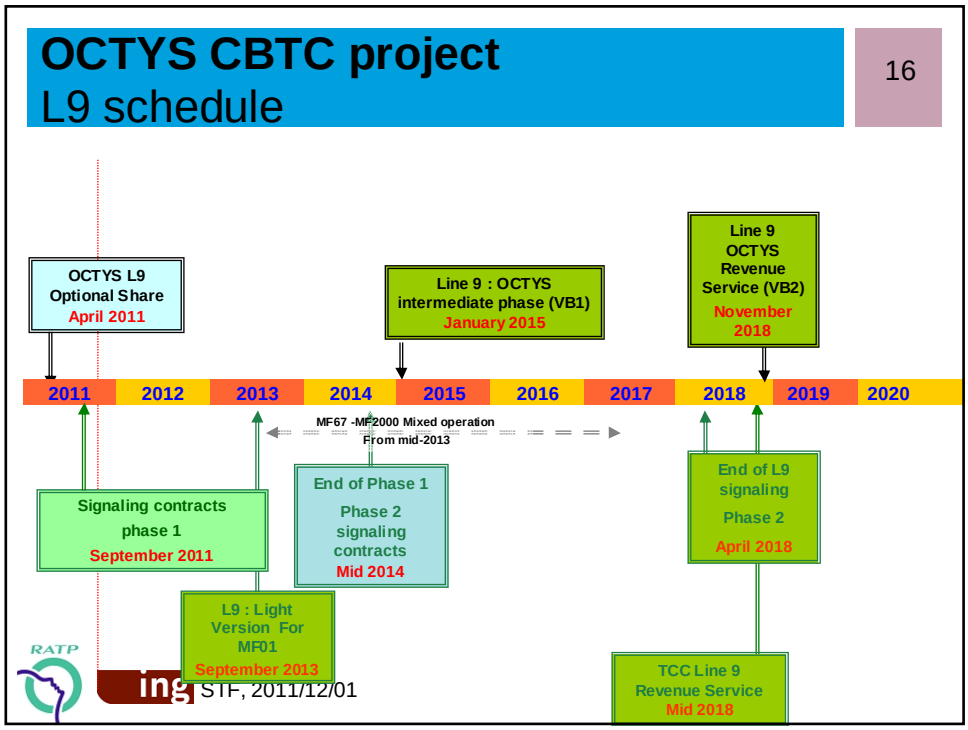
Interchangeability tests focused on L3
Summer 2009
Line 3 OCTYS Revenue Service (VB2)
January 2012
Line 5 OCTYS Revenue Service (VB2)
End of 2013
OCTYS Contract
March 2004
Interchangeability standard
April 2007
Line 3 : OCTYS intermediate phase (VB1)
March 2010
Line 5 : OCTYS intermediate phase (VB1)
2nd half of 2012
Mixed fleet op. 18months
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
MF67 -MF2000 Mixed operation From beginning of 2011
Signaling contracts
March 2004 - Nov. 2005
End of L3 signaling
September 2009
End of L5 signaling
Beginning 2012
Testing track
May 2005
TCC Line 3 Revenue Service
September 2009
L5 : Light Version For MF01
June 2011
TCC Line 5 Revenue Service
mid-2012
RATP
ing
STF, 2011/12/01


OCTYS CBTC project
L9 schedule
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OCTYS L9 Optional Share
April 2011
Line 9 : OCTYS intermediate phase (VB1)
January 2015
Line 9 OCTYS Revenue Service (VB2)
November 2018
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
MF67 -MF2000 Mixed operation From mid-2013
Signaling contracts phase 1
September 2011
End of Phase 1
Phase 2 signaling contracts
Mid 2014
End of L9 signaling
Phase 2
April 2018
L9 : Light Version For MF01
September 2013
TCC Line 9 Revenue Service
Mid 2018
RATP
ing
STF, 2011/12/01

OCTYS CBTC project
Migration strategy

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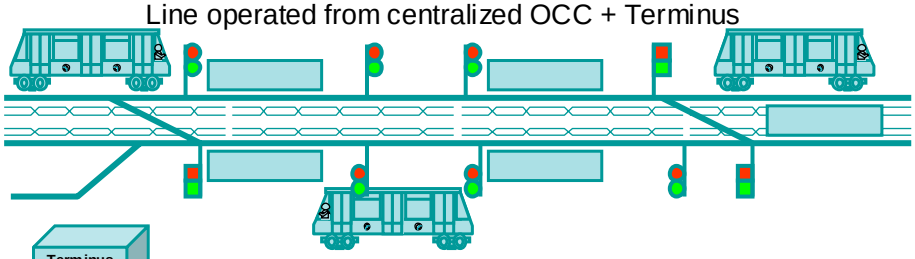
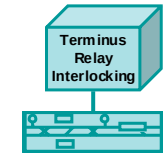
Current situation

Trains operated in block mode with ATP/ATO
(Speed Code ATC using magnetic loops)
Line operated from centralized OCC + Terminus





Terminus Control Room

Former Automatic Train Control (ATC)
Speed Code Magnetic Loops

OCTYS CBTC project
Migration strategy

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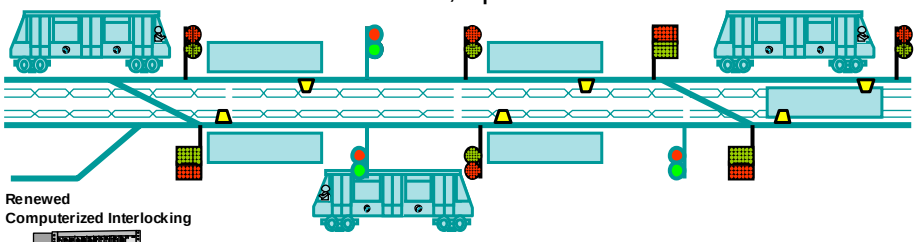
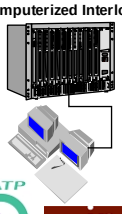
Step 1: renewal of signals (LED) and interlocking

new interlocking functions under a night/day switch

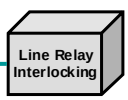
installation of beacons, optical barriers & radio AP



Renewed
Computerized Interlocking



Beacon



OCTYS CBTC project
Migration strategy

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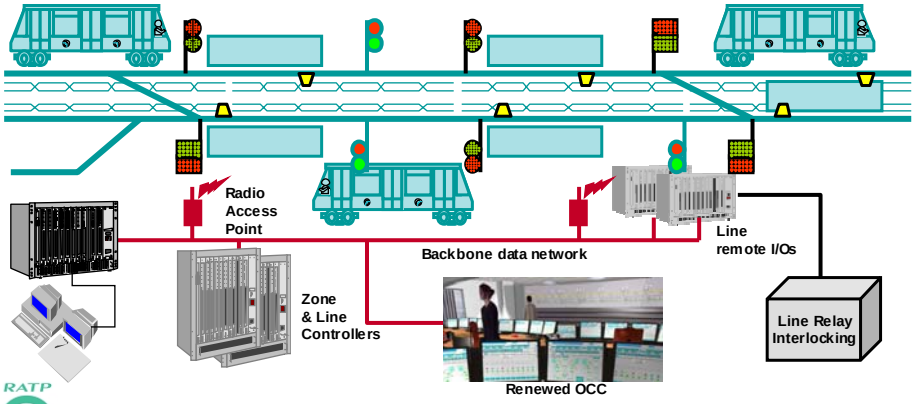
Step 2: CBTC Installation & tests at night, OCC renewal



RATP ing STF, 2011/12/01

OCTYS CBTC project
Migration strategy

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Step 3: first train in revenue service in CBTC m
mixed train operation: block mode perfo
Drivers training using a “train simulator”

RATP ing STF, 2011/12/01

OCTYS CBTC project
Migration strategy

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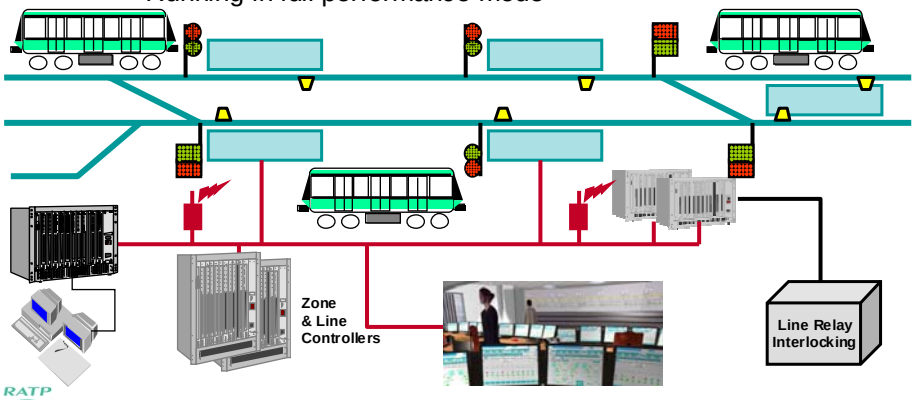
Step 4: Signals simplification and cancellation active
Removal of former ATC magnetic loops
All trains in revenue service in CBTC mode
Running in full performance mode



OCTYS CBTC project
Key challenges & lessons learnt

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Key Challenge

To maintain good level of line availability
- No service disruption during migration
- Reliability of the new system since the start of the revenue service

Figures achieved

Line 3: CBTC OCTYS type 2 (w/o line capacity increase)
- 650 nights for system testing & commissioning (late arrival of a “system test bench”)
- No service interruption

1 year to achieve an equivalent level of availability compared with legacy ATC

Lessons learnt

Test tracks, system test benches, and “shadow mode testing” are of utmost benefit

Possibility of long time tests without passengers on site to be valuable for availability (done on UTO line 1)

OCTYS CBTC project
Key challenges & lessons learnt

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Key Challenge

Synchronize System migration with Signalling renewal and Rolling Stock replacement

Figures achieved

Line 3: CBTC OCTYS type 2 (w/o line capacity increase)

Signalling renewal late in terminus, leading to a “CBTC service limited to main section of tracks: excluding of terminus” for 1 year.

Line 5: CBTC OCTYS type 1 (with line capacity increase)

Signalling works complexity not enough anticipated led to postpone system deployment

=> New trains arriving, operated manually but needing to install a “simplified trainborne equipment”.

Lessons learnt

Unlock signalling renewal program with CBTC installation (done for the coming next L9)

Anticipate system “minimum requirements” for operation of new trains before complete CBTC deployment:

Allow for progressive migration strategies

Envisage “standalone” mode of operation for trainborne equipment

OCTYS CBTC project
Key challenges & lessons learnt

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Key Challenge

Minimize costs for CBTC

Figures achieved

CBTC OCTYS (L3, 5, 9, 10 & 12)

Open competition for 5 lines with a single specification, contracted with 3 suppliers (interchangeability basis)

5 lines contracted for 100 M€$_{2004}$ (CBTC only, excl. of ATS and Signalling)

Lessons learnt

Standardize specifications as far as possible

Group (when possible) several lines in a single contract

Keep competition opened with several suppliers: interchangeability

OCTYS CBTC project
Key challenges & lessons learnt

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Key Challenge

Minimize impact on operating rules

Figures achieved

CBTC w/o line capacity increase (fixed block mode: OCTYS type 2 on L3)

Stricly same op. rules but a great number of incidents linked to ergonomics factors.
As for ex:
Zero speed detection needs a delay (~1") for the CBTC
: but drivers didn't use to wait that much before changing the master mode selector for turn-back operation => EB applied
With CBTC, the minimum safety distance for approaching a stabled train is about 8m. This may be reduced with a speed limit at 7 KPH: many drivers are tripped with this limit.

CBTC with Cab-Signal (OCTYS type 1 on L5)

Special care to be brought on the Cab-Signal ergonomics. This ergonomic constraint might reduce some performances of the system (SACEM experience)

Lessons learnt

Consider ergonomics factors: a digital system actually does not react same as analog ones.

Extensive use of training simulators is of utmost benefit for smooth migration.

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Thank you for your attention