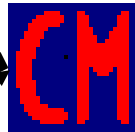
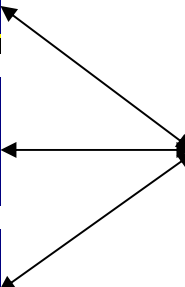


# TMS at Work

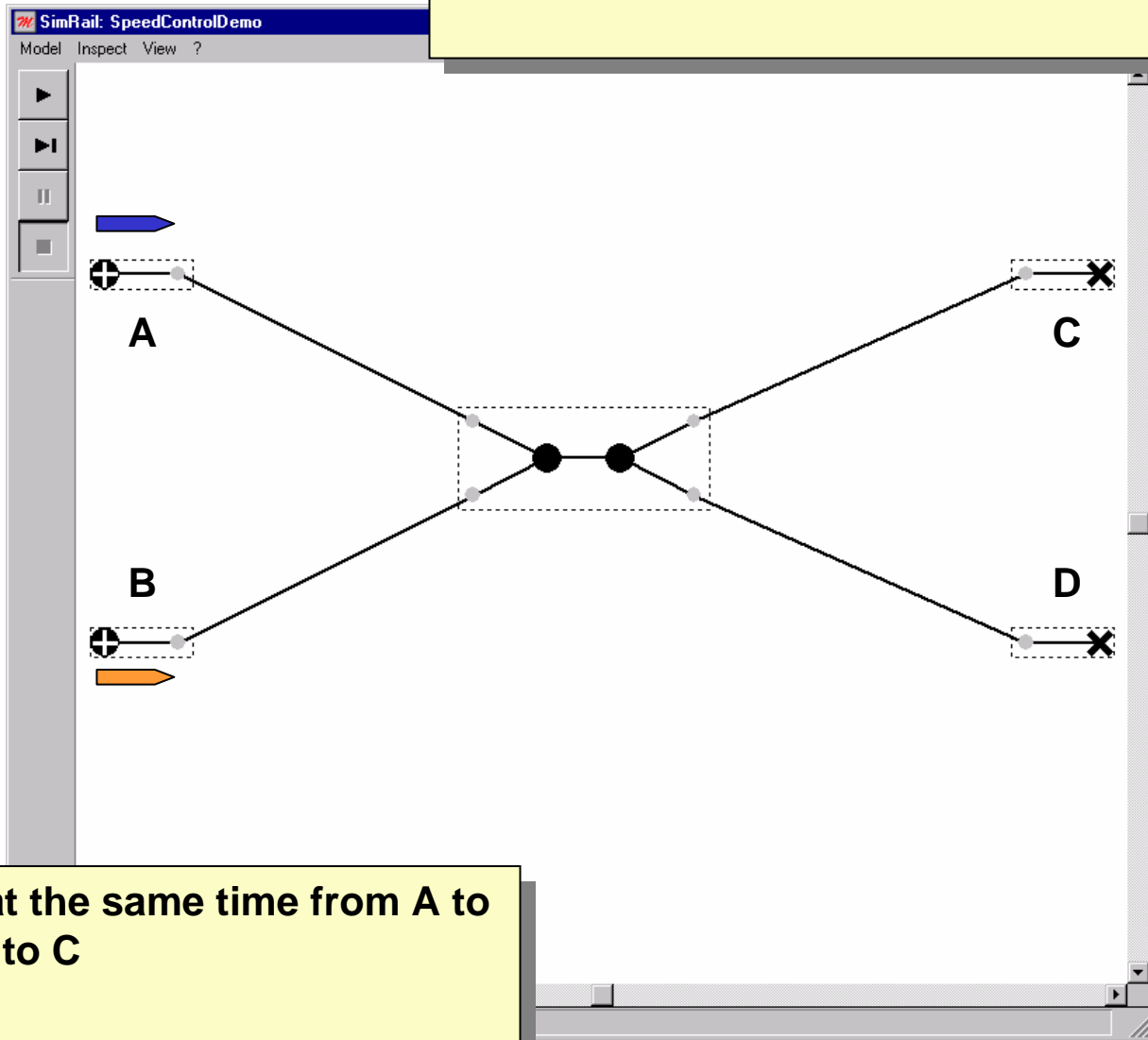


X Model



# COMBINE

- Symmetrical infrastructure
- Two TGVs equal in characteristics



Trains leave at the same time from A to D and from B to C

# COMBINE

The screenshot displays two windows from the 'COMBINE' software. The top window, 'Train Describer', shows a graphical representation of a railway layout with two intersecting tracks. The bottom window, 'TimeTable', displays a table of train schedules. A yellow callout box highlights the 'Entry Time' and 'Exit Time' columns for two trains, indicating they are scheduled to enter and exit simultaneously.

Train	Type	Description	Rule	Priority	Entry Node	Exit Node	Day	Entry Time	Entry Delay	Exit Time	Exit Delay	Initial Speed	Final Speed	Alarms
101	-1		50	50	0	7	07 May 2001	16:00	00:00	16:13		231 km/h	231 km/h	
102	-1		51	50	6	452	07 May 2001	16:00	00:00	16:13		231 km/h	231 km/h	

Mon 07 May 2001 16:01:00

**Trains are expected to enter and exit simultaneously...**

# COMBINE

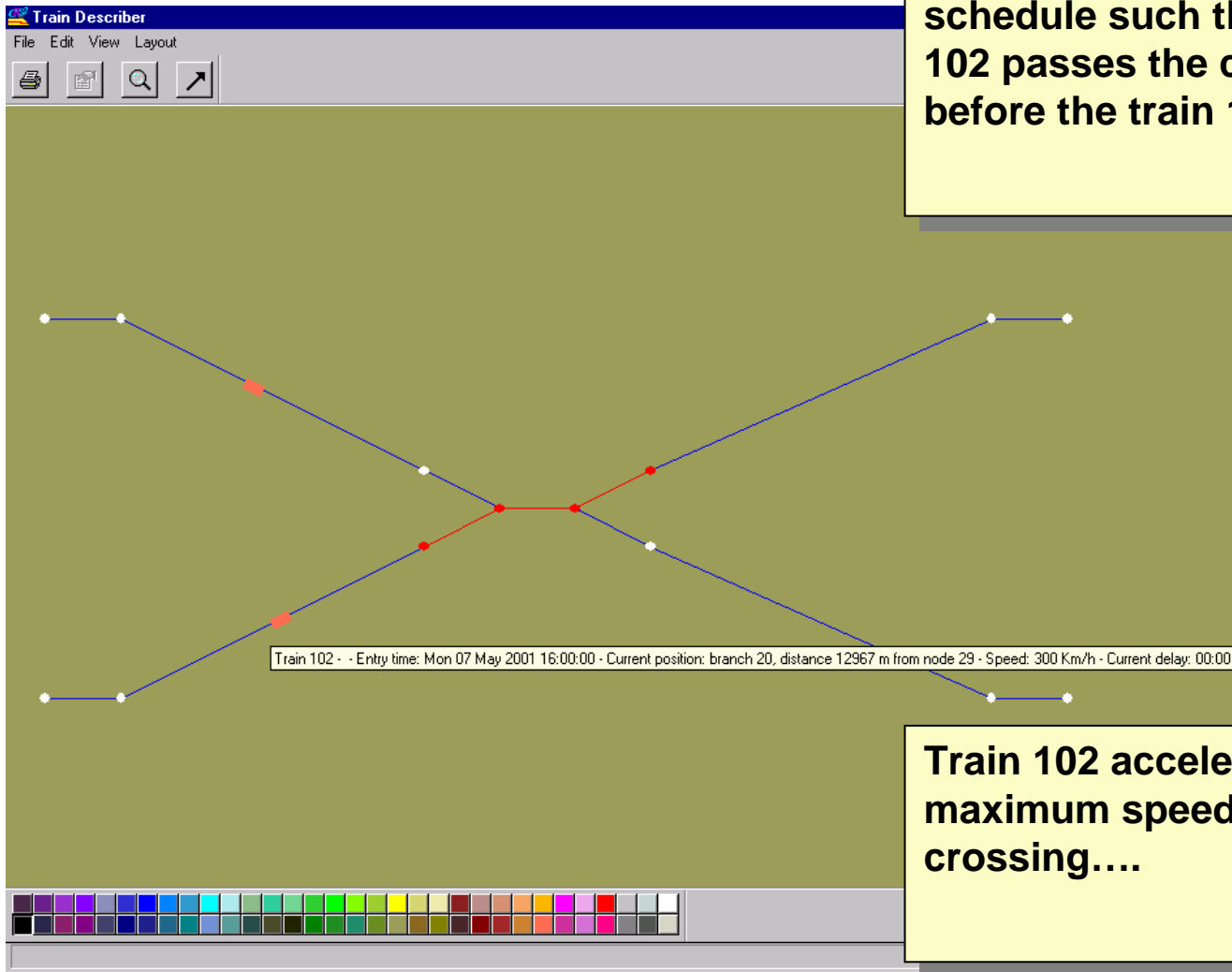
A crossing conflict is detected...

... and solved by speed adaptation

The screenshot shows two windows from the Train Describer software. The main window, titled "Train Describer", displays a network diagram with green lines and nodes. A central crossing point is highlighted with a yellow oval, indicating a detected conflict. The "Speedometer" window is open in the foreground, showing a table of train parameters. The table has columns for Train, Description, Rule Description, Speed (km/h), Travelled (km), and Delay (hh:mm:ss). The speed values for trains 101 and 102 are highlighted with yellow boxes.

Train	Description	Rule Description	Speed (km/h)	Travelled (km)	Delay (hh:mm:ss)
101	Thalys 1 stel		221	5.054000	00:00:01
102	Thalys 1 stel		257	5.392000	00:00:01

Mon 07 May 2001 16:01:50



**CRS1 defines a new train schedule such that the train 102 passes the crossing before the train 101**

**Train 102 accelerates at its maximum speed before the crossing....**

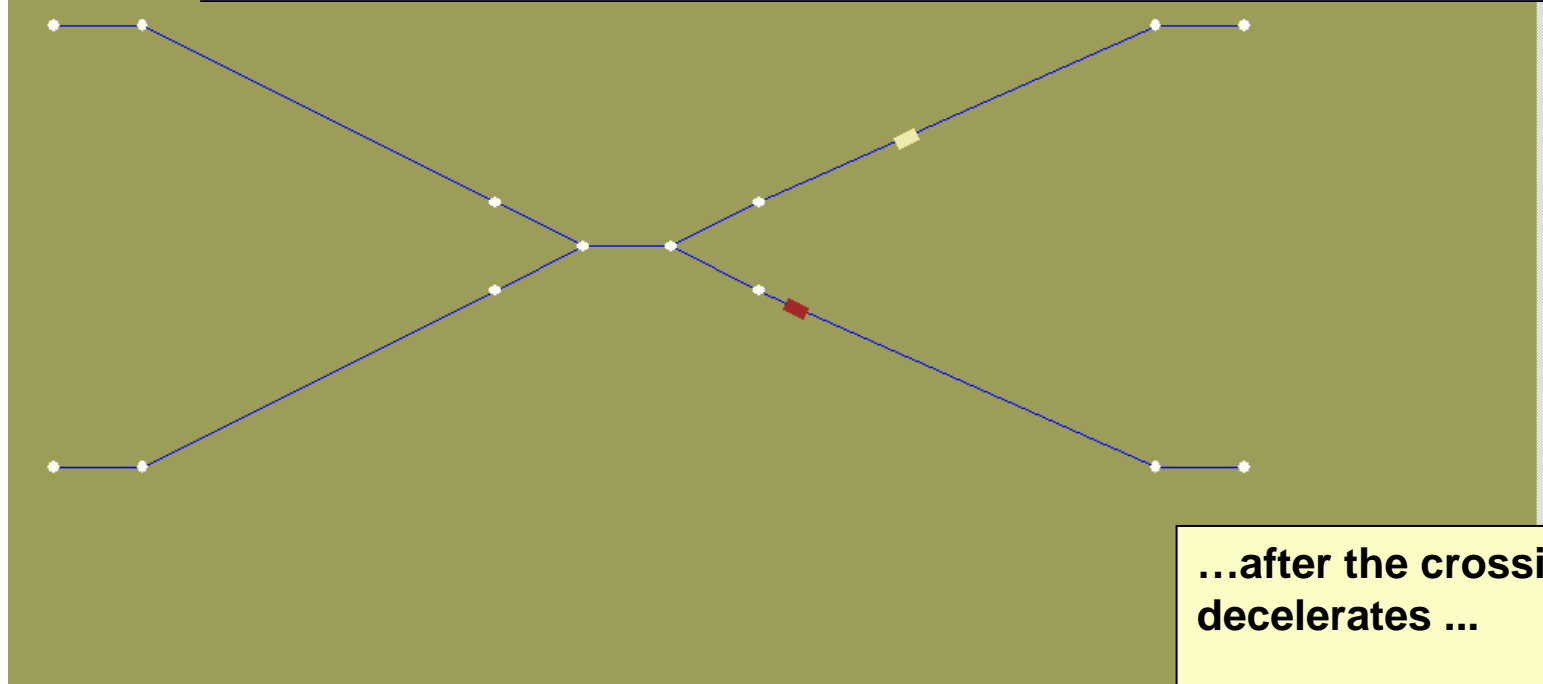
# COMBINE

Train Describer Speedometer

File Parameters

Train	Description	Rule Description	Speed (km/h)	Travelled (km)	Delay (hh:mm:ss)
101	Thalys 1 stel		265	32.043000	00:00:01
102	Thalys 1 stel		227	38.773000	00:00:01

Mon 07 May 2001 16:09:00



...after the crossing it decelerates ...

# COMBINE

... and train 101 accelerates at its maximum speed

The screenshot shows the 'Train Describer' software interface. At the top, there is a menu bar with 'File', 'Edit', 'View', and 'Layout'. Below the menu is a toolbar with icons for printing, saving, zooming, and panning. The main workspace is a greenish-brown area containing a railway network diagram with several nodes and connecting lines. A train icon, consisting of a red rectangle and a black circle, is positioned on one of the lines. A status bar at the bottom of the workspace displays the following information: 'Train 101 - - Entry time: Mon 07 May 2001 16:00:00 - Current position: branch 24, distance 17577 m from node 27 - Speed: 300 Km/h - Current delay: 00:00'. At the bottom of the window, there is a color palette and a status bar with 'Edit' and 'Mon 07 May 2001 16:12:00'.



Train	Type	Description	Rule	Priority	Entry Node	Exit Node	Day	Entry Time	Entry Delay	Exit Time	Exit Delay	Initial Speed	Final Speed	Alarms
101	-1		50	50	0	7	07 May 2001	16:00	00:00	16:13	00:00	231 km/h	231 km/h	
102	-1		51	50	6	452	07 May 2001	16:00	00:00	16:13	00:00	231 km/h	231 km/h	

**Both trains exit on time....**

**....and the total consumed energy is equal to:**

- train 101: 1260 kW/h**
- train 102: 1075 kW/h**





TMS switched off

X Model

# COMBINE

No conflict is detected, so trains run at the same speed and request the same infra at the same time....

The screenshot shows the 'Train Describer' software interface. The main window displays a track diagram with two intersecting paths. The paths are represented by blue lines with white dots at the ends and red dots at the intersection. A yellow text box on the left contains the text: "No conflict is detected, so trains run at the same speed and request the same infra at the same time....". Below the track diagram is a 'Speedometer' window with a table of train parameters.

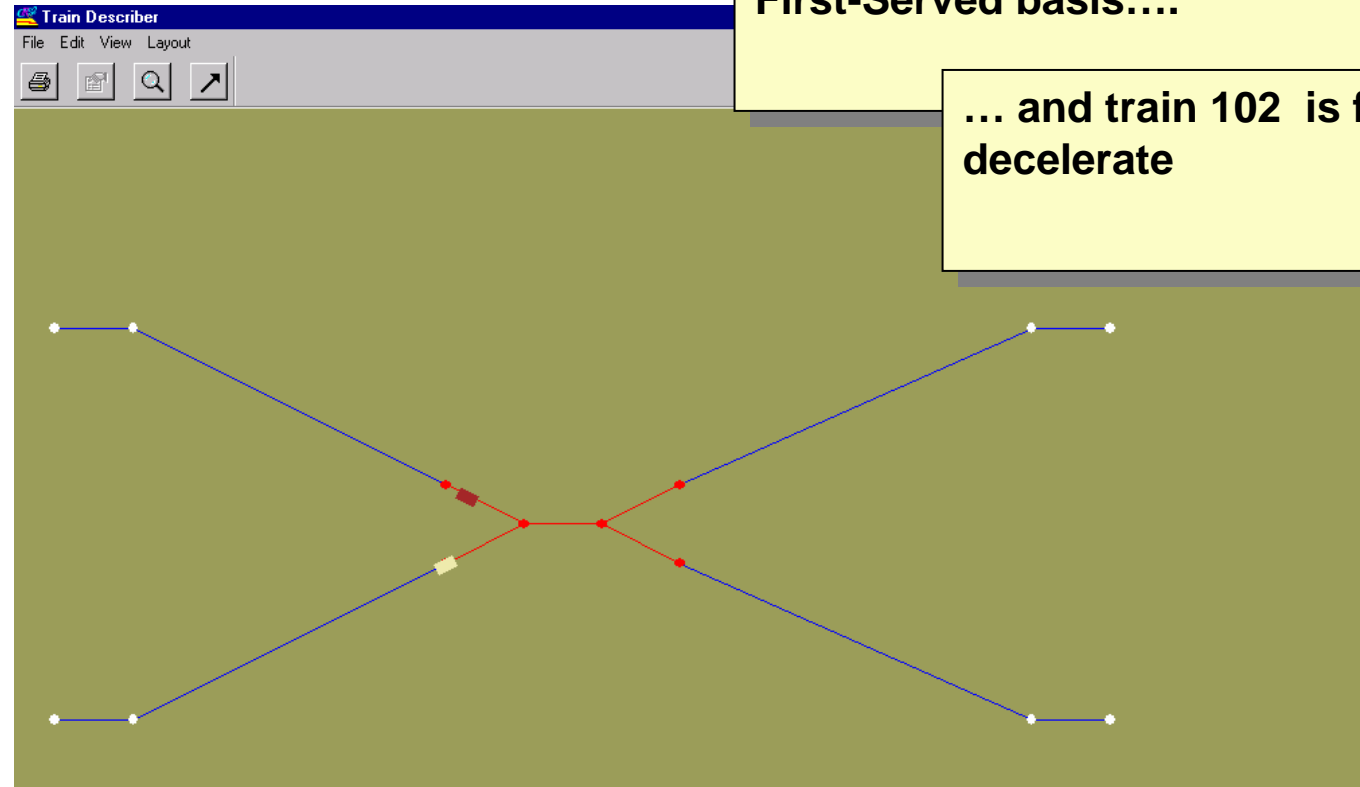
Train	Description	Rule Description	Speed (km/h)	Travelled (km)	Delay (hh:mm:ss)
101	Thalys 1 stel		230	14.120000	00:00:01
102	Thalys 1 stel		230	14.120000	00:00:01

Mon 07 May 2001 16:04:10

# COMBINE

... routes are set on a First-Come-First-Served basis....

... and train 102 is forced to decelerate



Train	Description	Rule Description	Speed (km/h)	Travelled (km)	Delay (hh:mm:ss)
101	Thalys 1 stel		254	28.360000	00:00:01
102	Thalys 1 stel		74	26.171000	00:00:01

Mon 07 May 2001 16:07:50



After the crossing train 102 accelerates at its maximum speed...

The screenshot shows the "Train Describer" software interface. At the top, there is a menu bar with "File", "Edit", "View", and "Layout". Below the menu is a toolbar with icons for printing, saving, zooming, and panning. The main area is a greenish-brown background with a blue railway track layout consisting of several nodes and connecting lines. A red dot on the track represents the train. A tooltip box is positioned over the train, containing the text: "Train 102 - - Entry time: Mon 07 May 2001 16:00:00 - Current position: branch 470, distance 23438 m from node 473 - Speed: 300 Km/h - Current delay: 00:00". At the bottom of the window, there is a color palette and a status bar with "Edit" and "Mon 07 May 2001 16:14:55".



Train	Type	Description	Rule	Priority	Entry Node	Exit Node	Day	Entry Time	Entry Delay	Exit Time	Exit Delay	Initial Speed	Final Speed	Alarms	Modified
101	-1		50	50	0	7	07 May 2001	16:00	00:00	16:13	00:00	231 km/h	231 km/h		
102	-1		51	50	6	452	07 May 2001	16:00	00:00	16:13	00:01	231 km/h	231 km/h		

...but it isn't able to recover the delay totally.

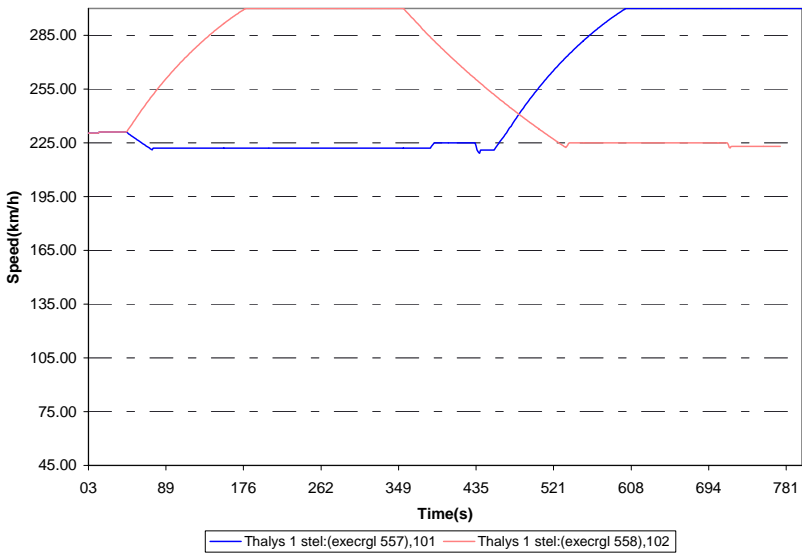
The total consumed energy is equal to:

- train 101: 1292 Kw/h
- train 102: 1449 Kw/h

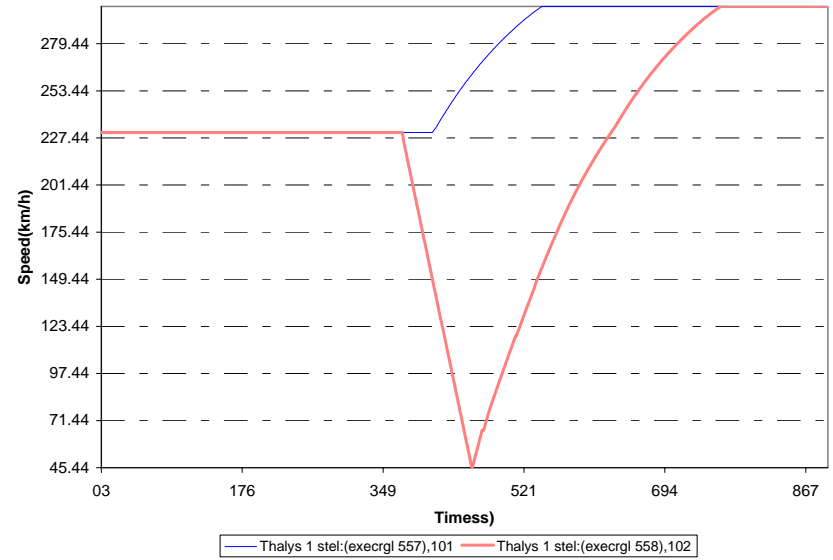


The speed/time graphs report the different behaviour of the trains if TMS is active or not

TMS On



TMS Off



Besides, with TMS active, a significant energy profit (17%) is achievable

