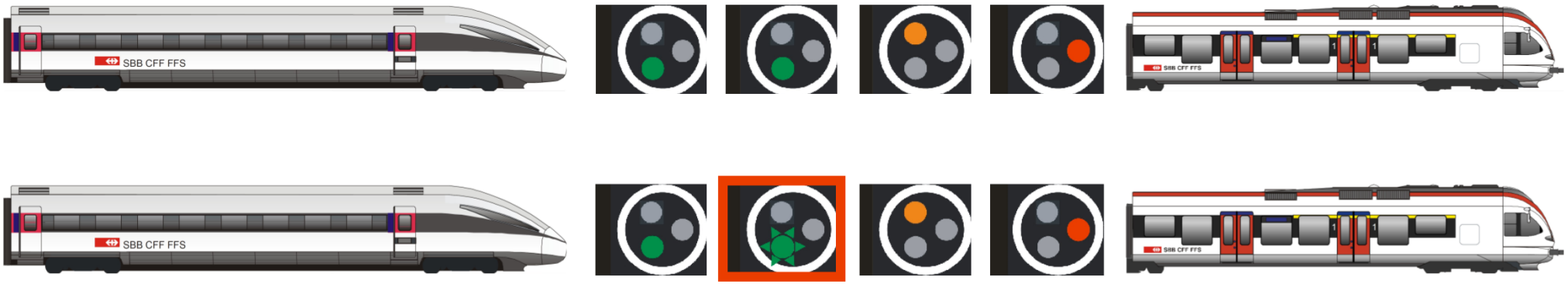
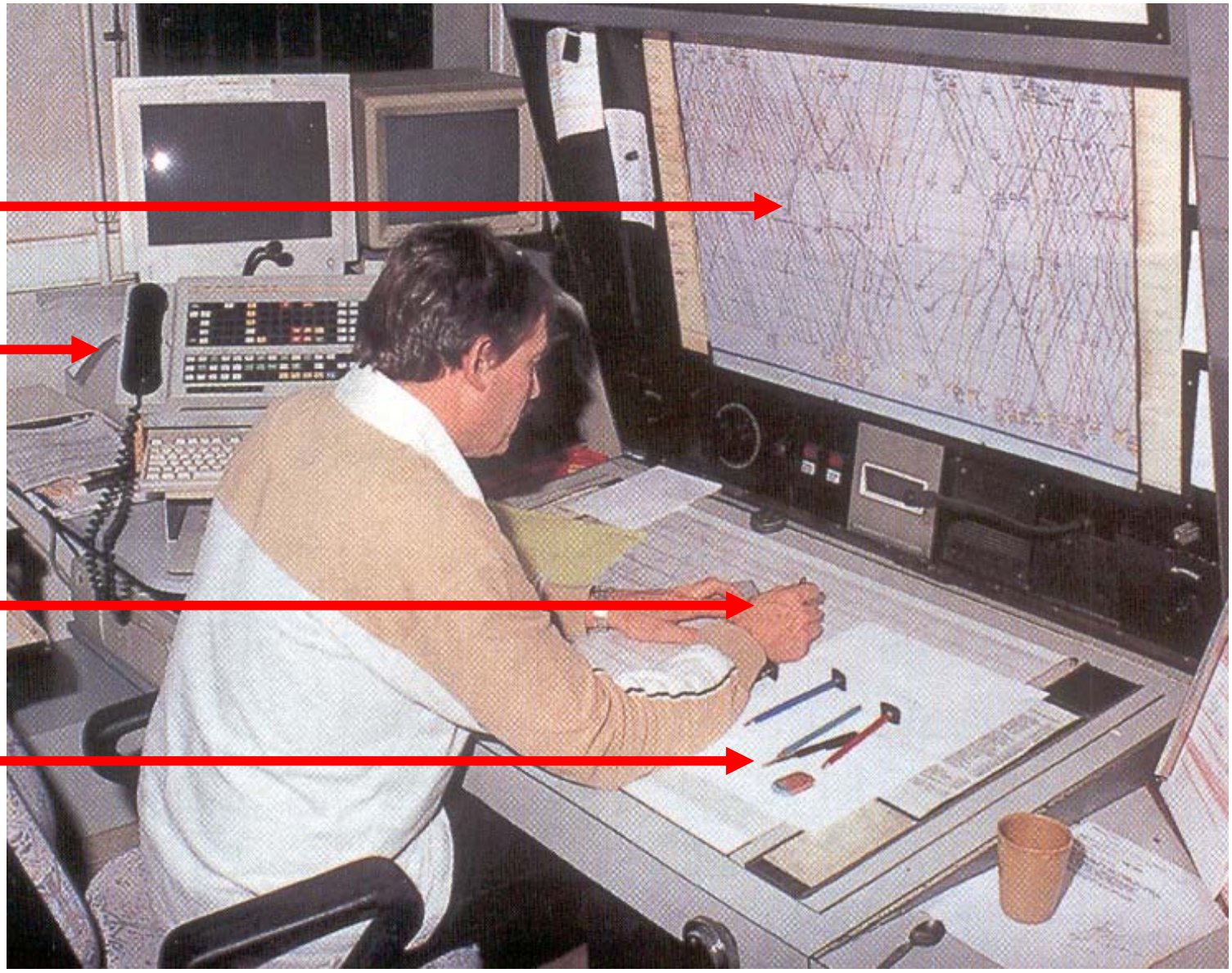
Why not a Last Clear signal Aspect (LCA) ?



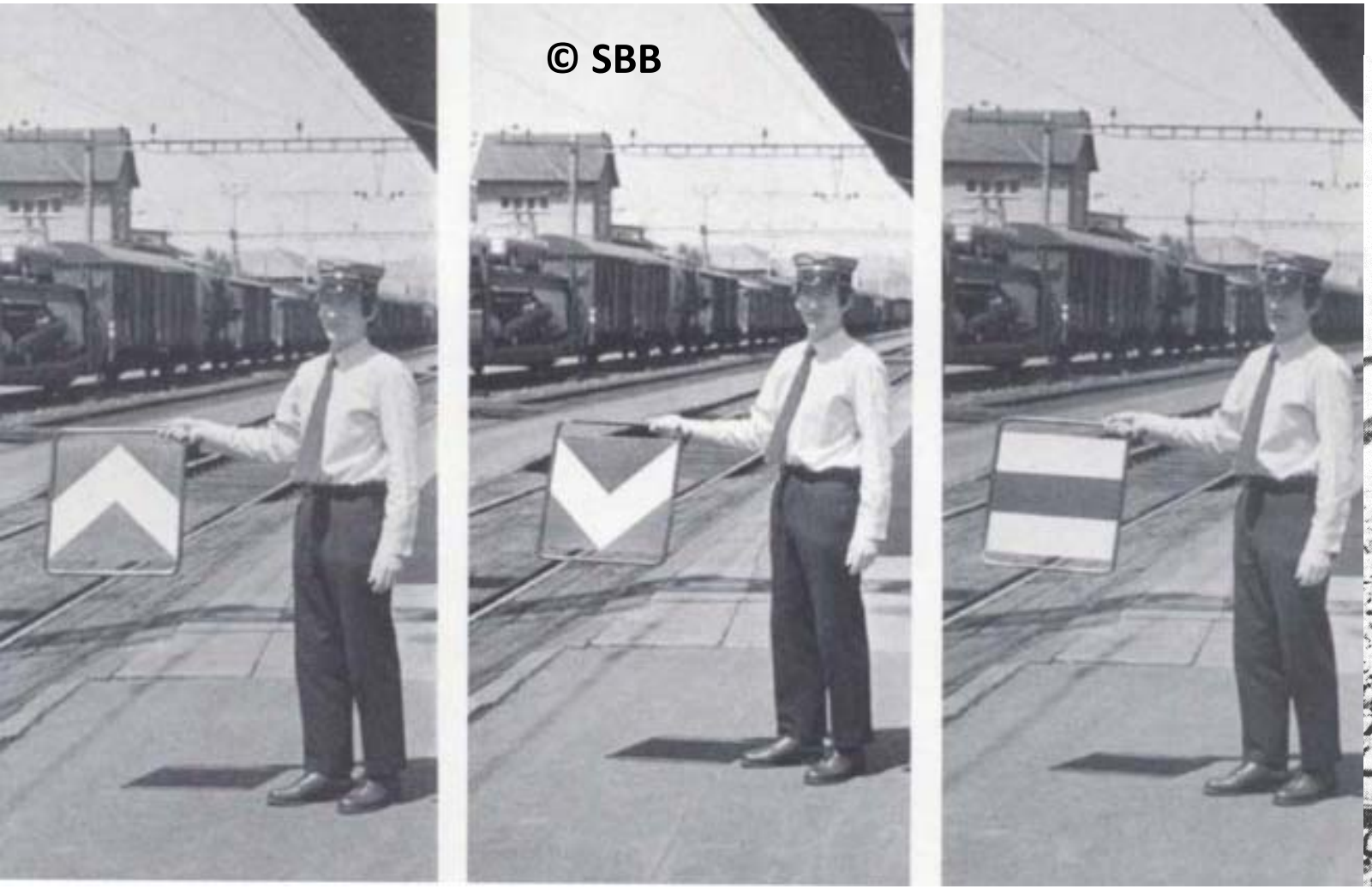
14th Swiss Transport Research Conference (STRC 2014)

14 - 16 May 2014, Monte Verità

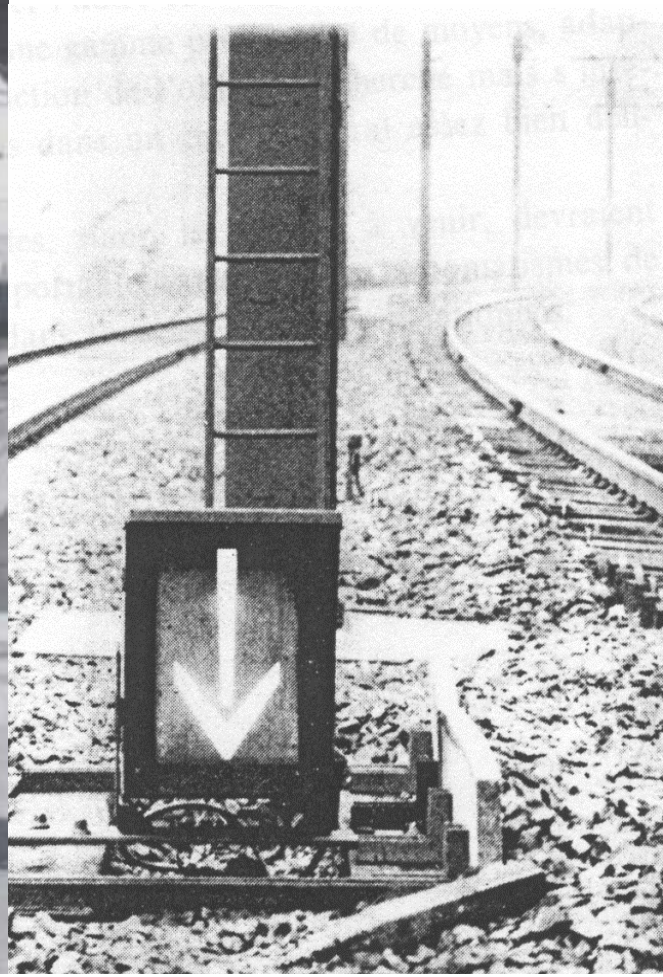
Former Driver Advisory System (DAS)



Pacing trains is already an old story



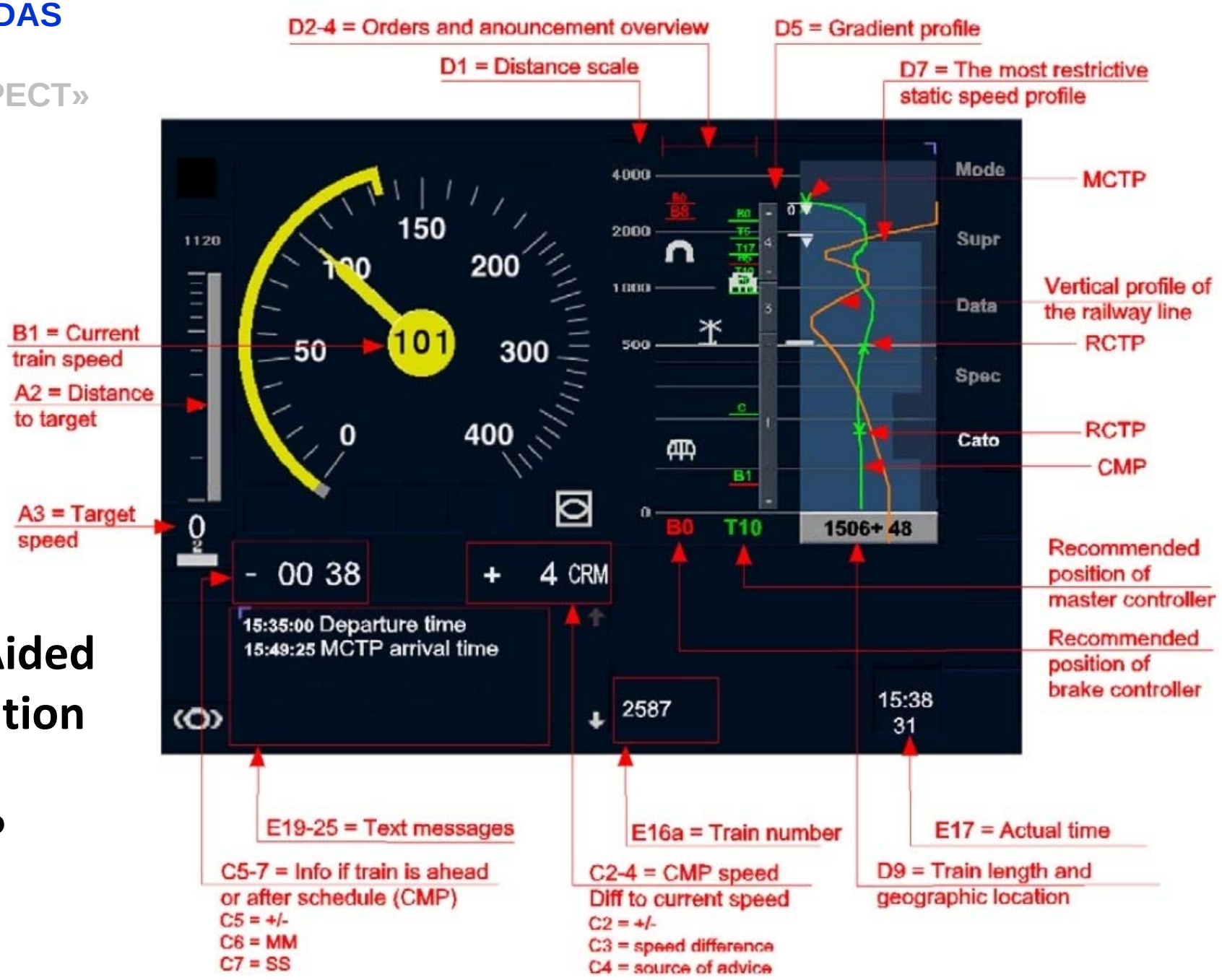
© SNCF



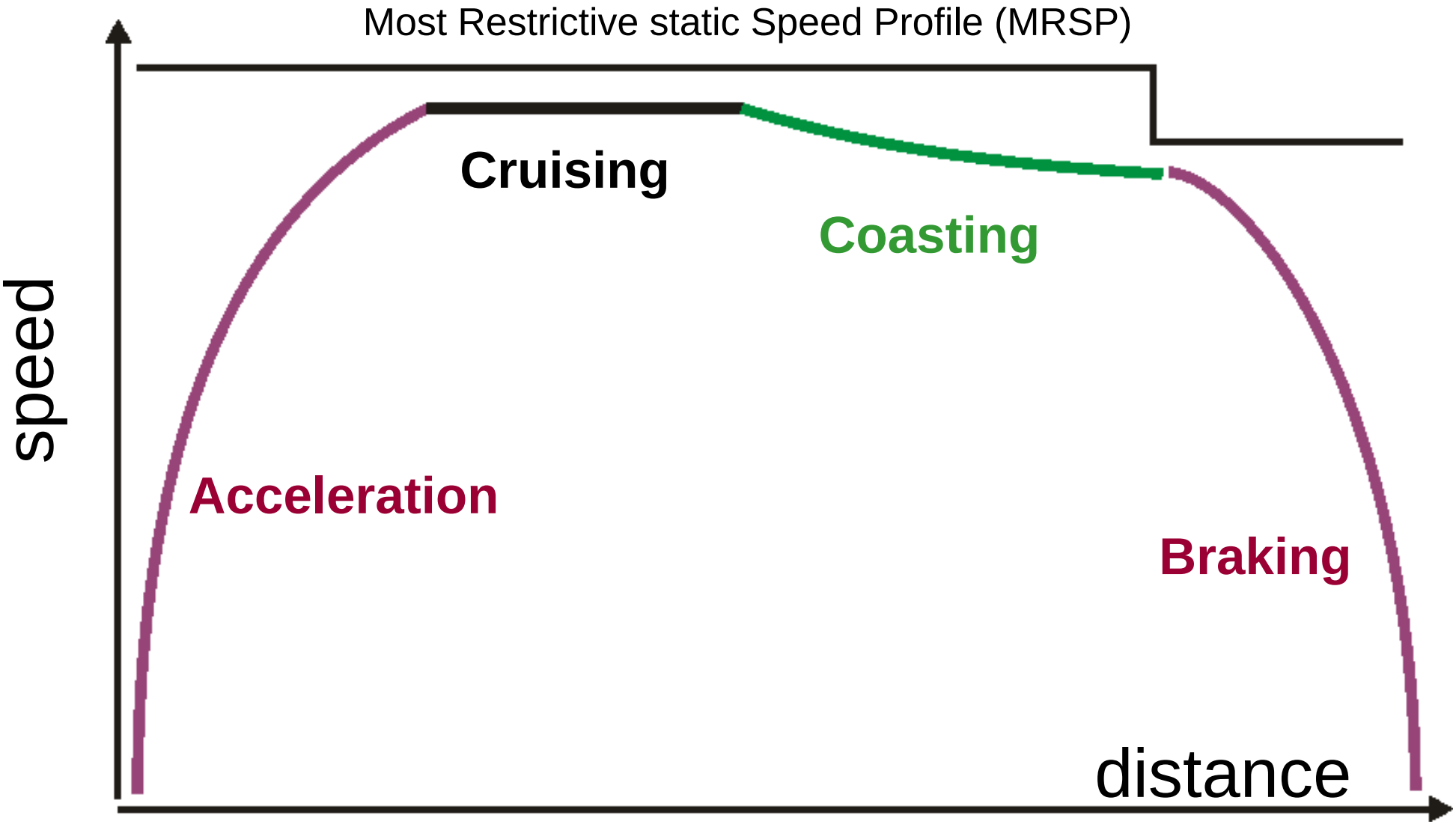
Denmark
Germany
Netherlands
Sweden
Switzerland

ADL
Admirail
CATO
DSM
GreenSpeed
RoutLint
ZLR

Computer-Aided Train Operation (CATO): DAS ??? → ATO



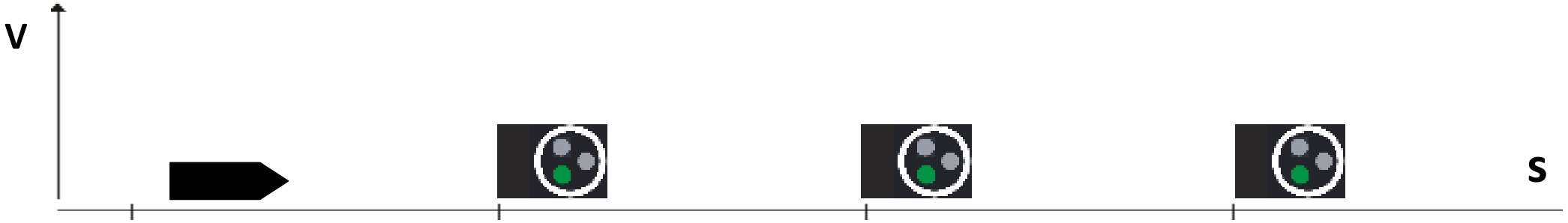
Little remain: main driving phases



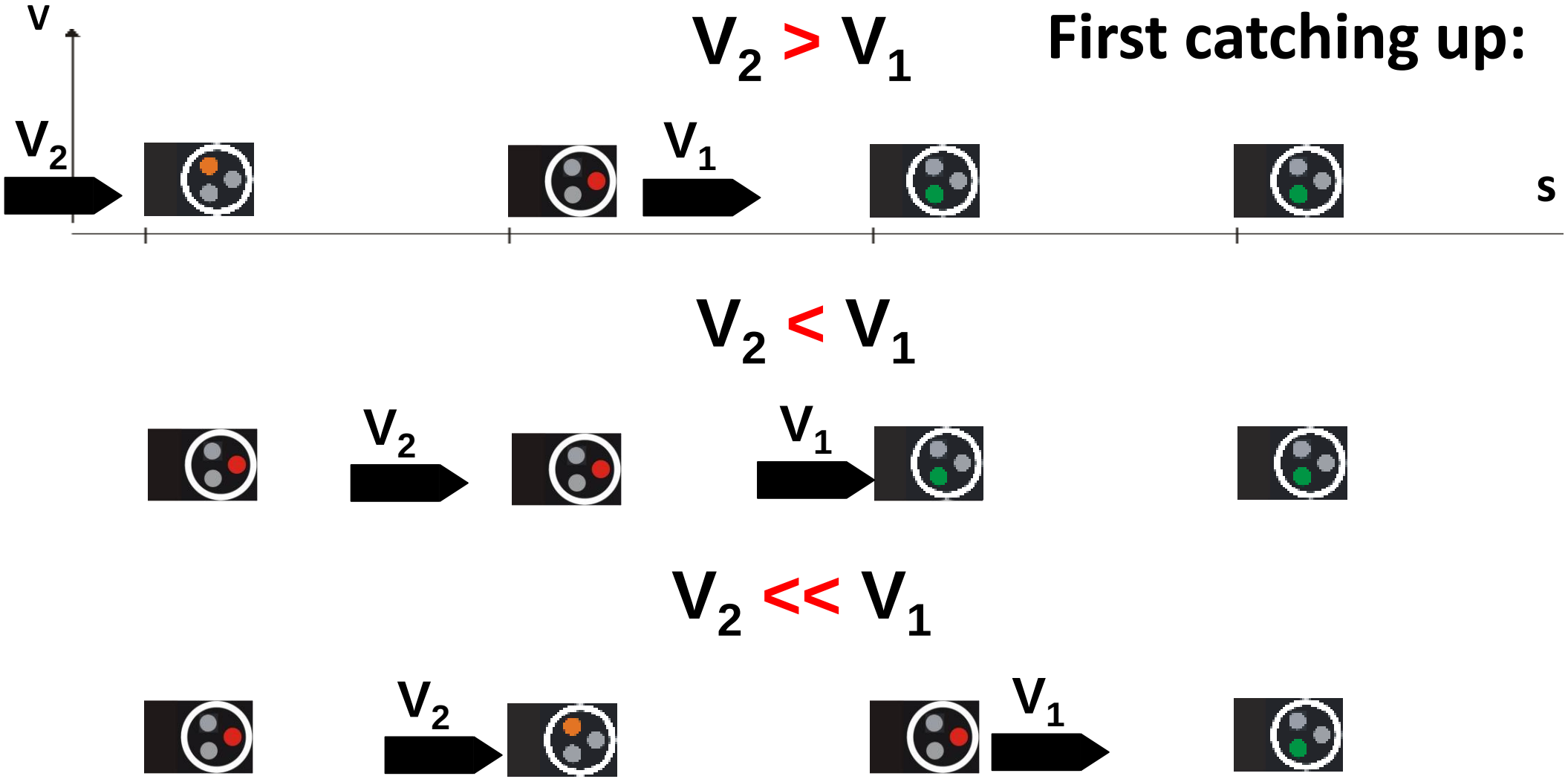
Running in-time:
Highly dependent on the experience of the driver

Normal driving style: appropriate use of the performance margin
- to coast at the appropriate places,
- to brake essentially with the regenerative brakes

Objectives:
- arrival on time
- energy savings, wear & tear savings, passenger comfort increase



Running late in case of catching up:
Highly dependent on the experience, on the knowledge and on the driving style of the driver

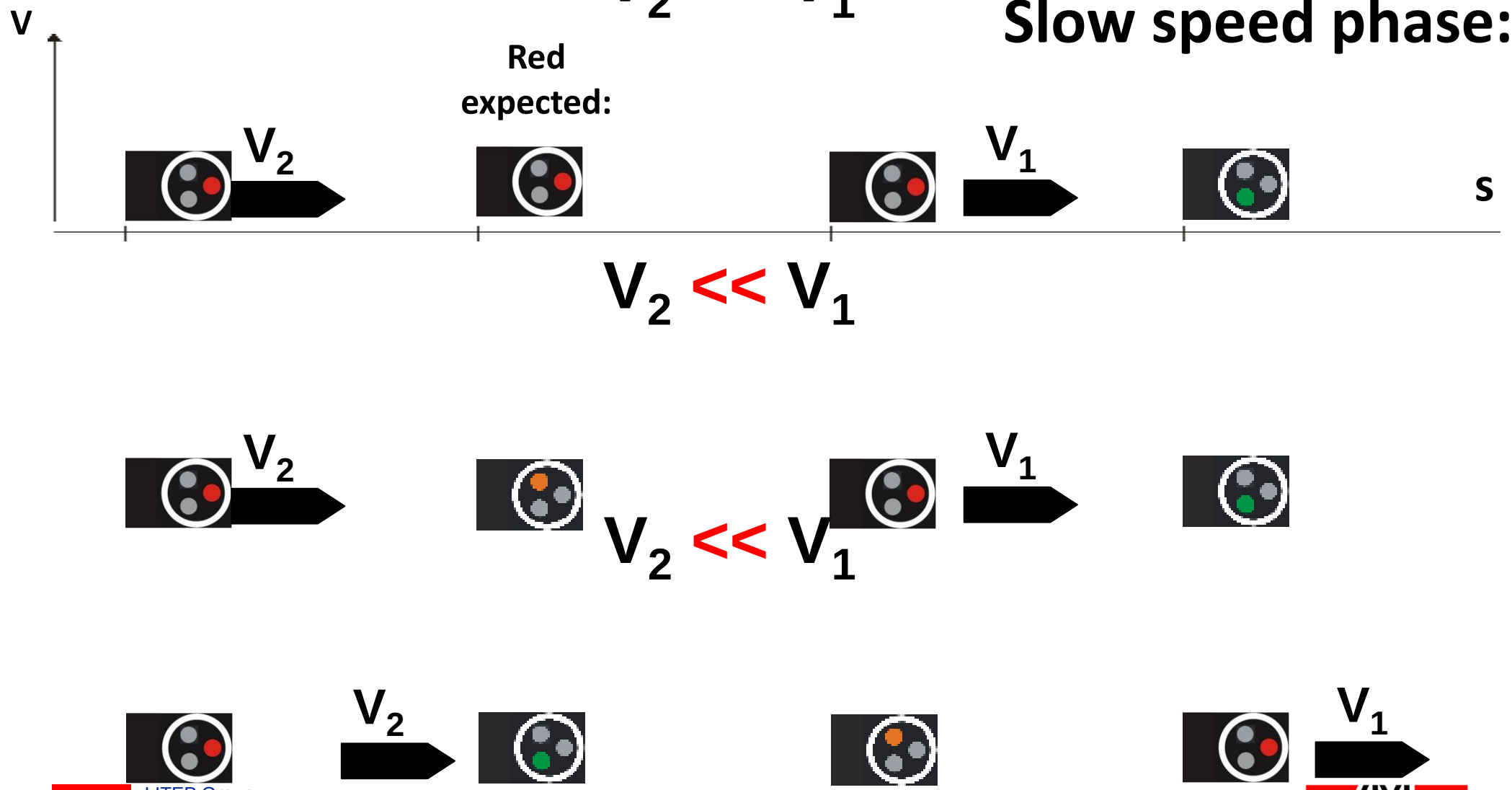


Running late in case of catching up:

The "intermediate" phase

$V_2 << V_1$

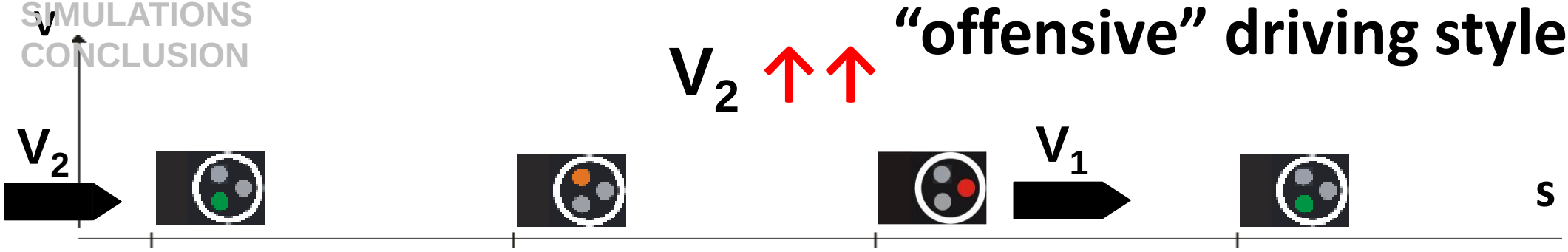
Slow speed phase:



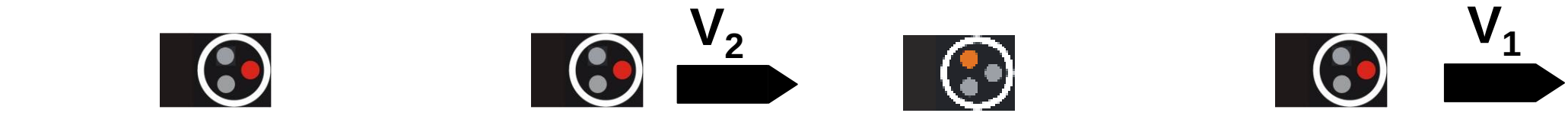
Running late in case of catching up:

The speeding up phase

"offensive" driving style:

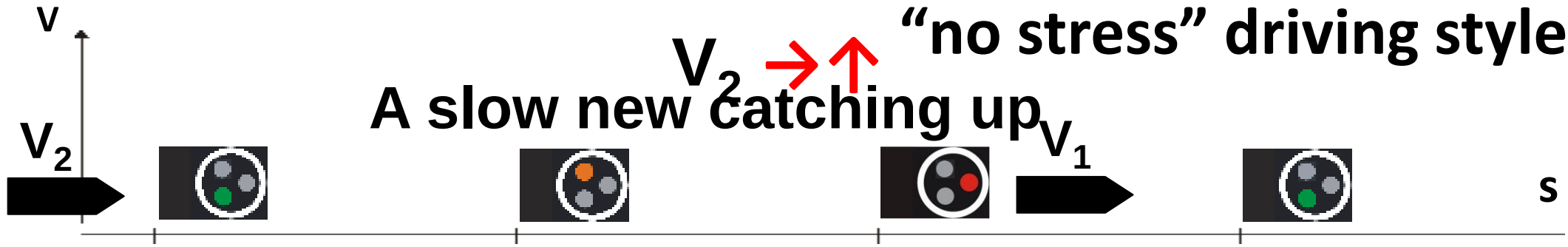


A very quickly new catching up



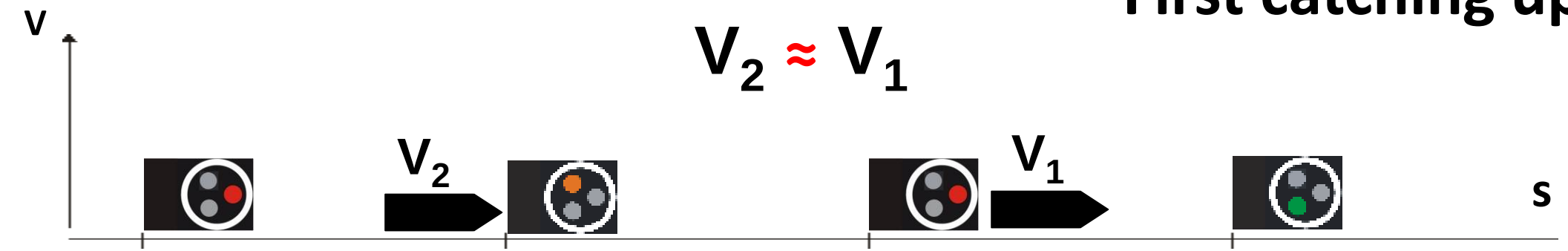
"no stress" driving style:

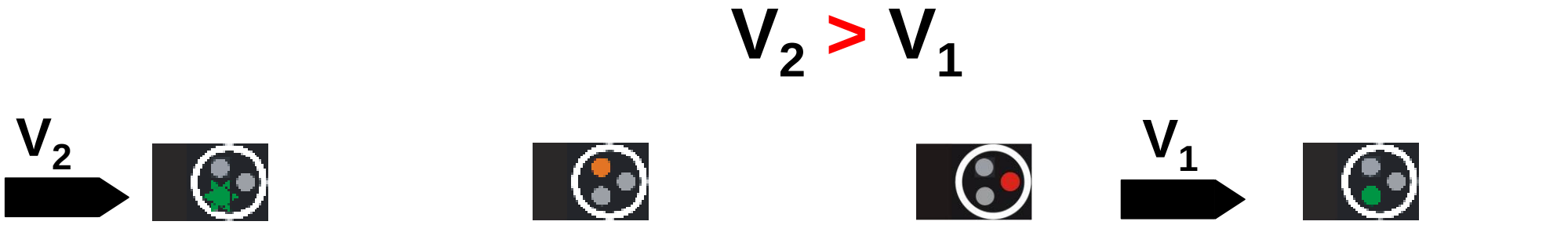
A slow new catching up

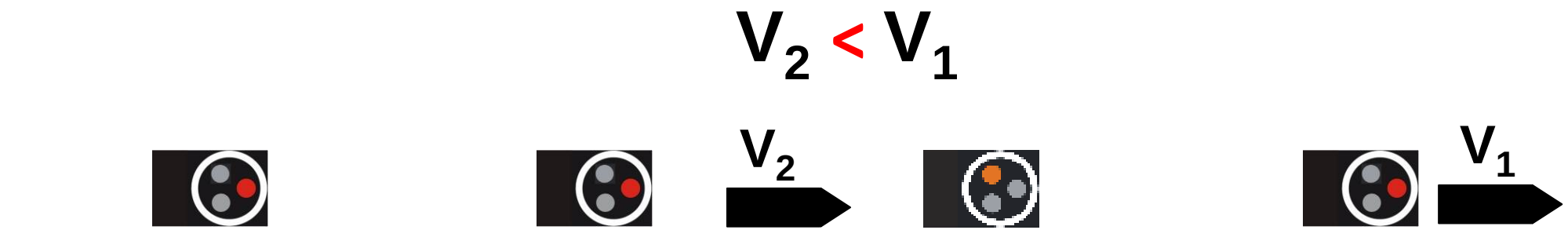


Running late in case of catching up: The help of the last clear signal aspect before braking

First catching up:



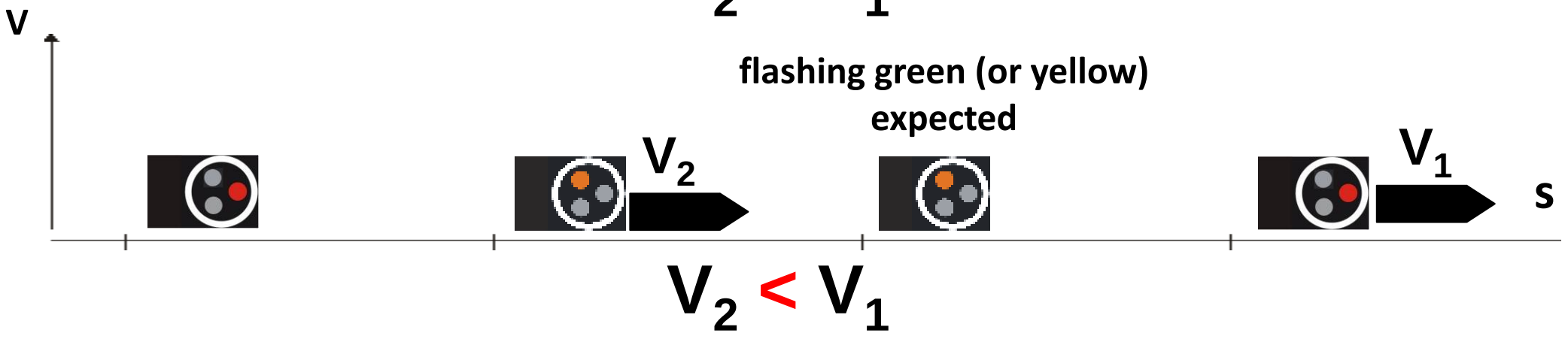


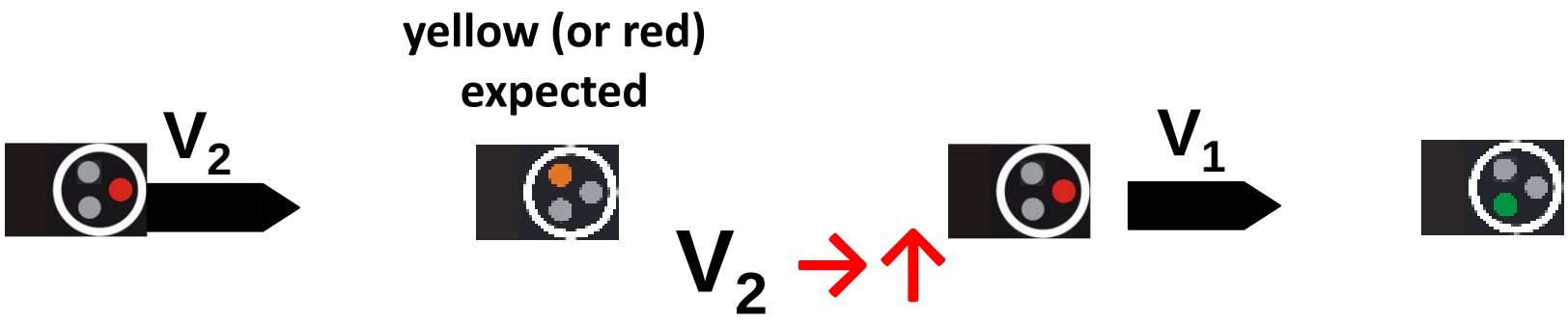


Running late in case of catching up: The help of the last clear signal aspect during the "intermediate" phase

Slow speed phase:

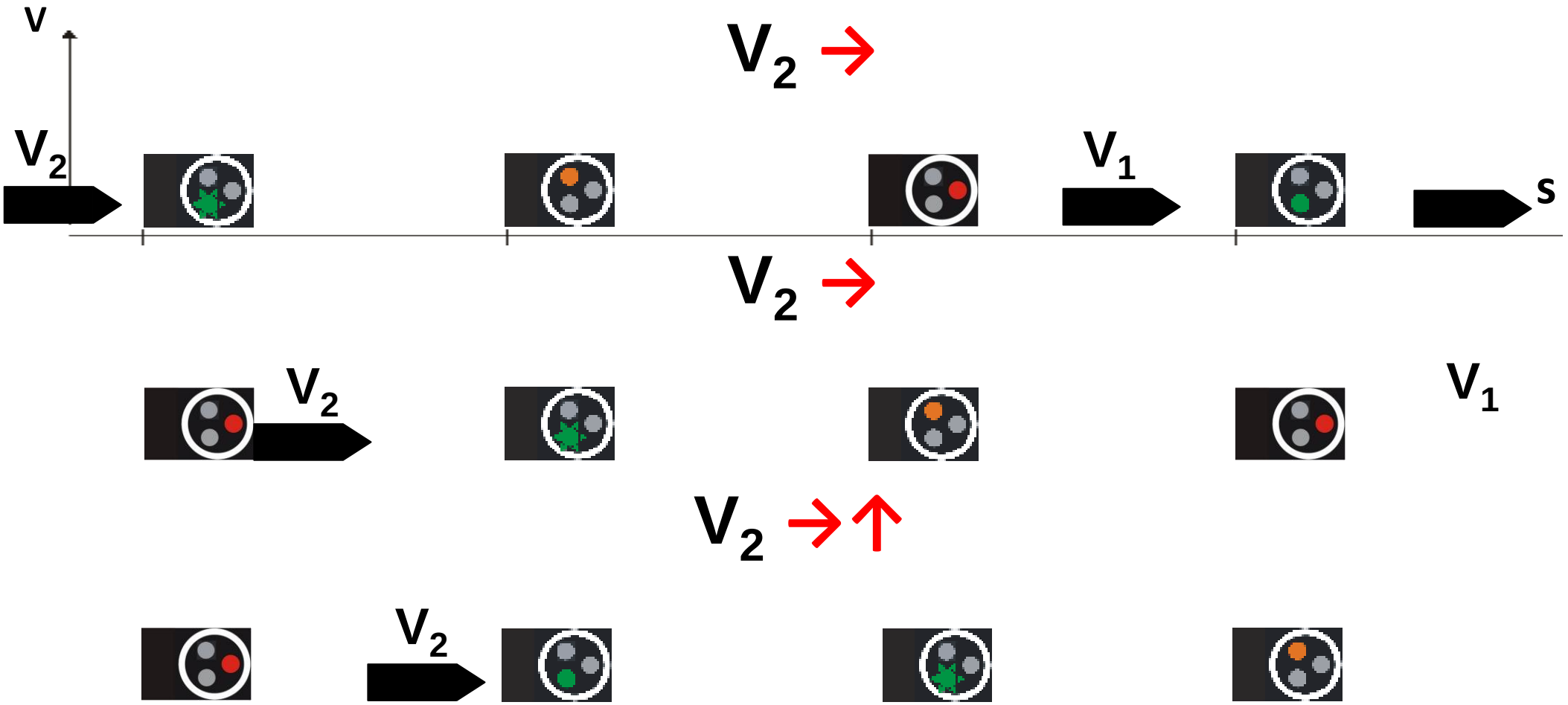
$V_2 < V_1$





Running late in case of catching up: The help of the last clear signal aspect before speeding up

"Last clear aspect" driving style:



SNCF – BAL Automatic “4”-aspect signaling system

2 wires from …

2 wires for …

blinking unit

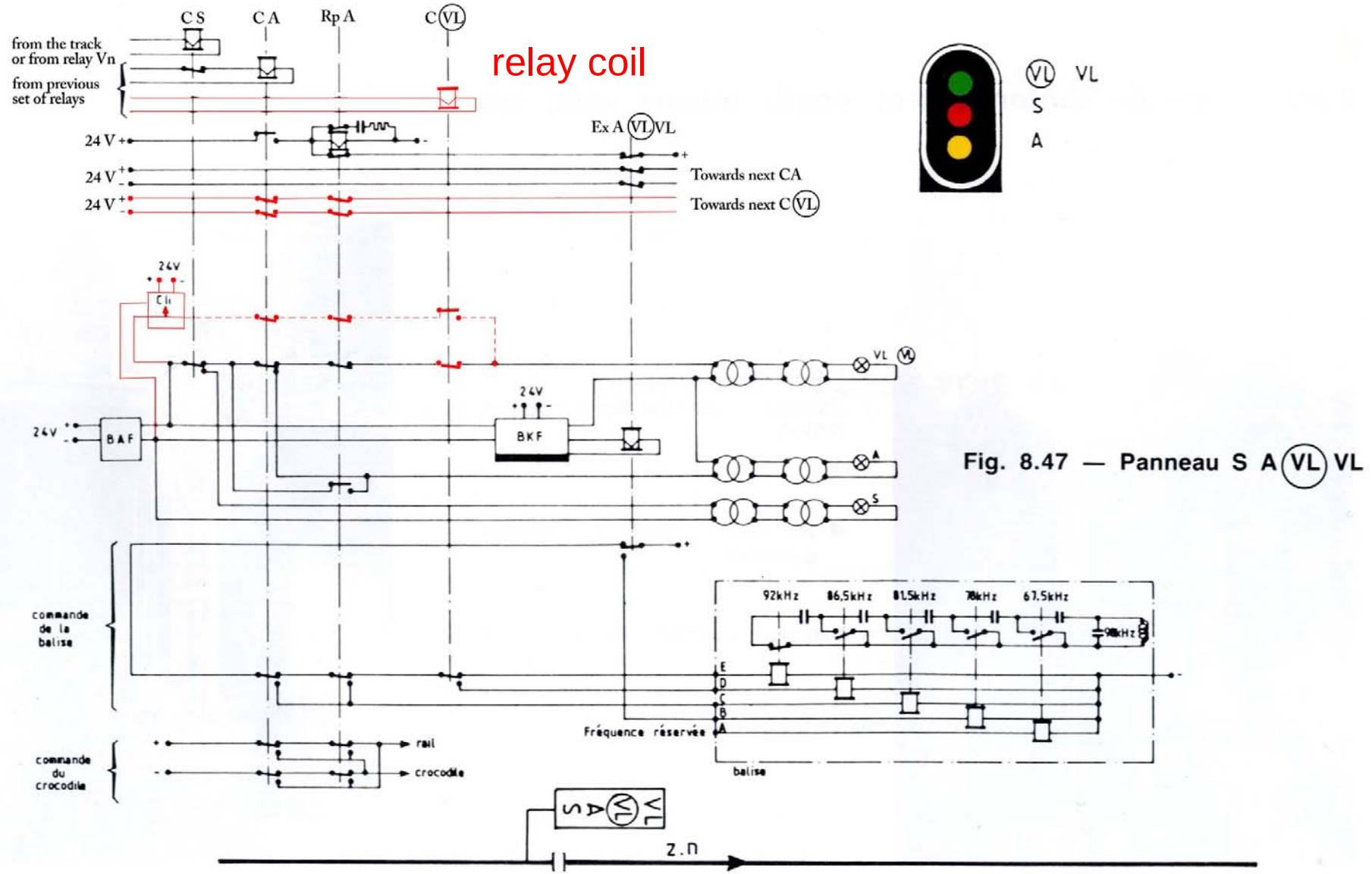


Fig. 8.47 — Panneau S A VL VL

from “Signalisation ferroviaire” – R. Rétivau (SNCF) – 1987

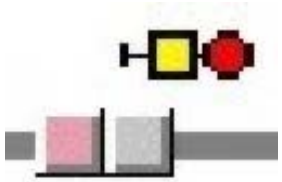
THEORETICAL

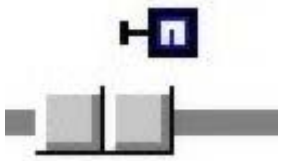
"last clear aspect" adv./cons. in case of train succession

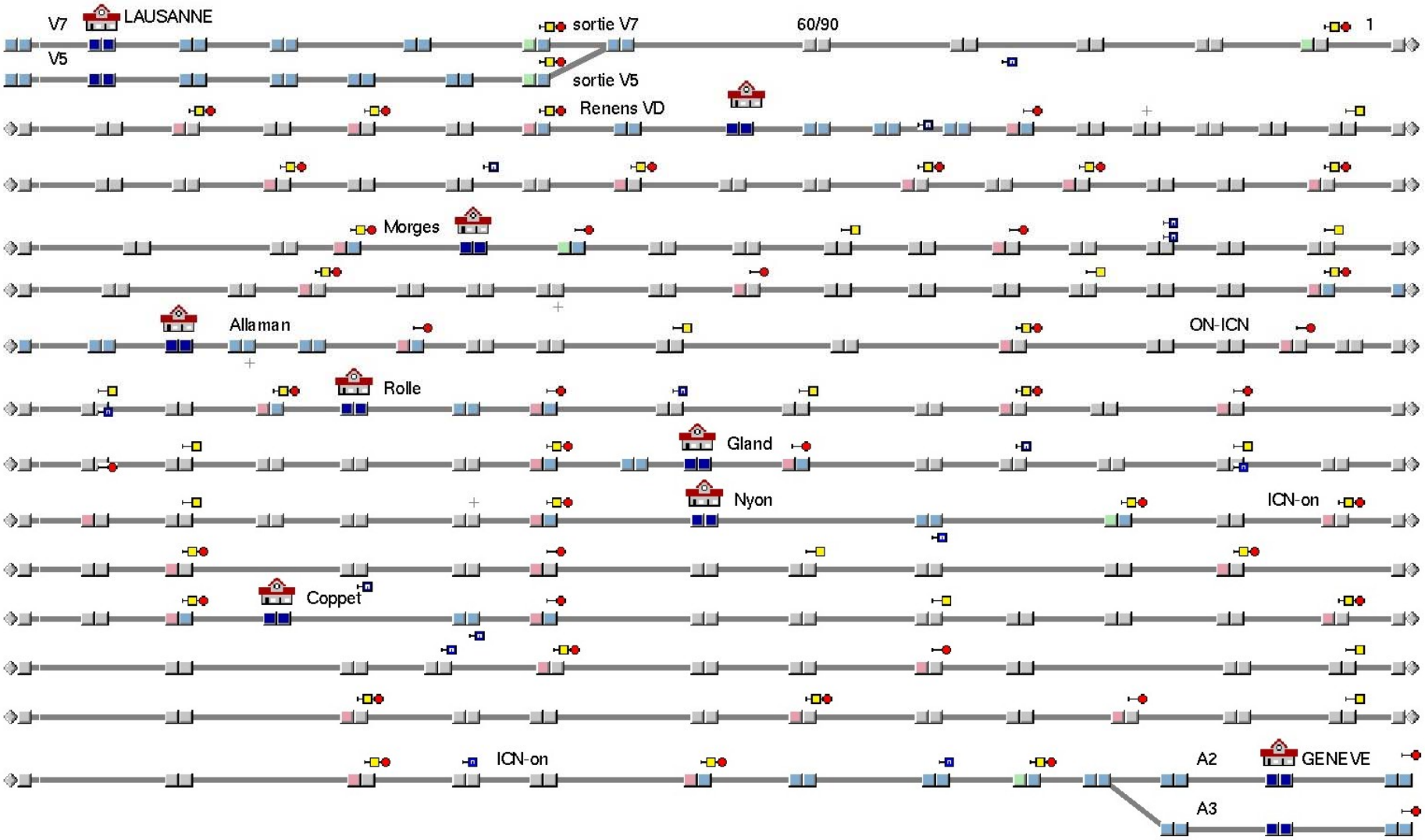
Effect of a "last clear" indication on …	ATP **without** release loop or beacon	AWS or ATP **with** release loop or beacon
Free flow / Timetable stability	**Very good**	**Good**
Energy consumption	**Very good (Good for EMU)**	**Good (No for EMU)**
Stress of the driver	**Very good**	**Good**

from "Simple ways to pace trains" – D. Emery (EPFL) ICIRT-2013 (Pékin)

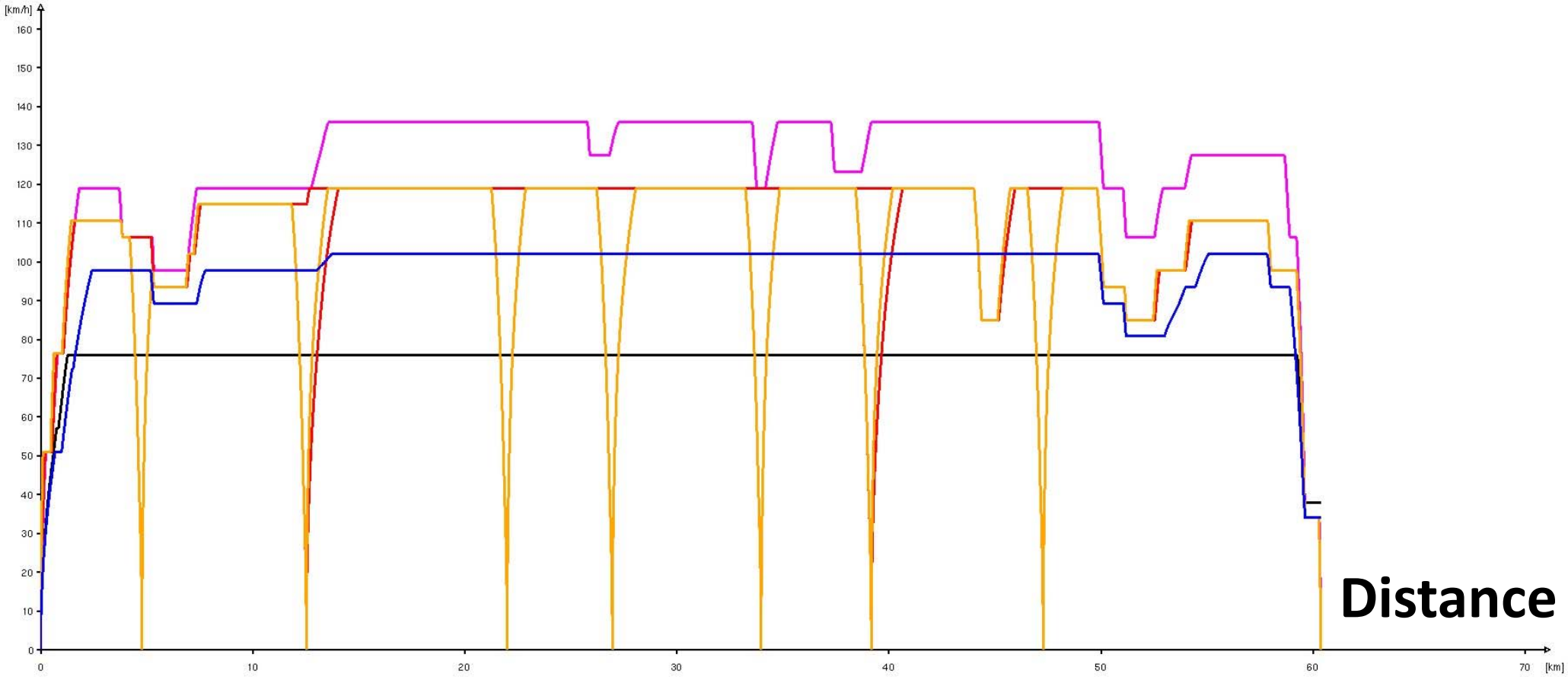
Line length:
Approximately 60 km (Lausanne-Genève)



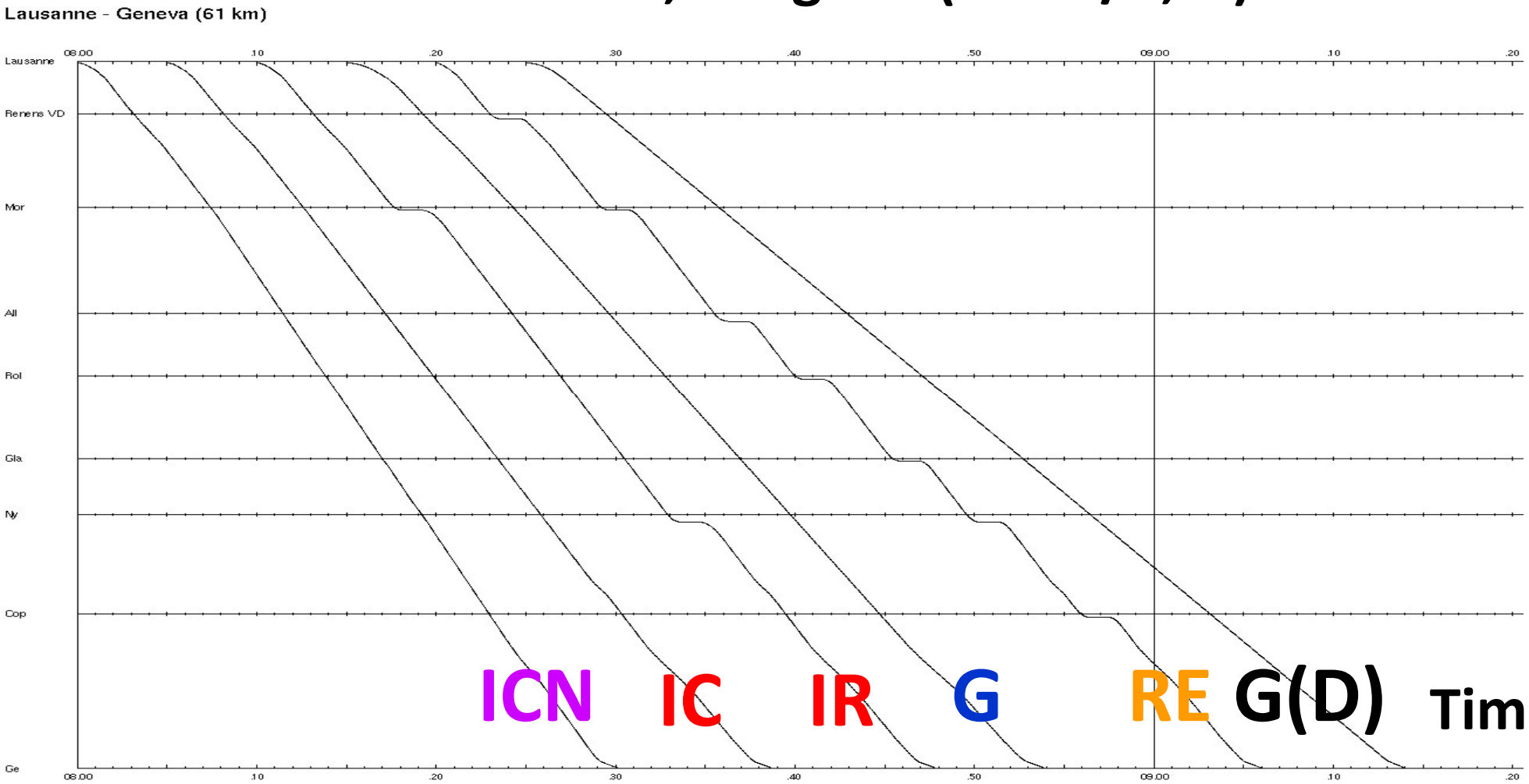




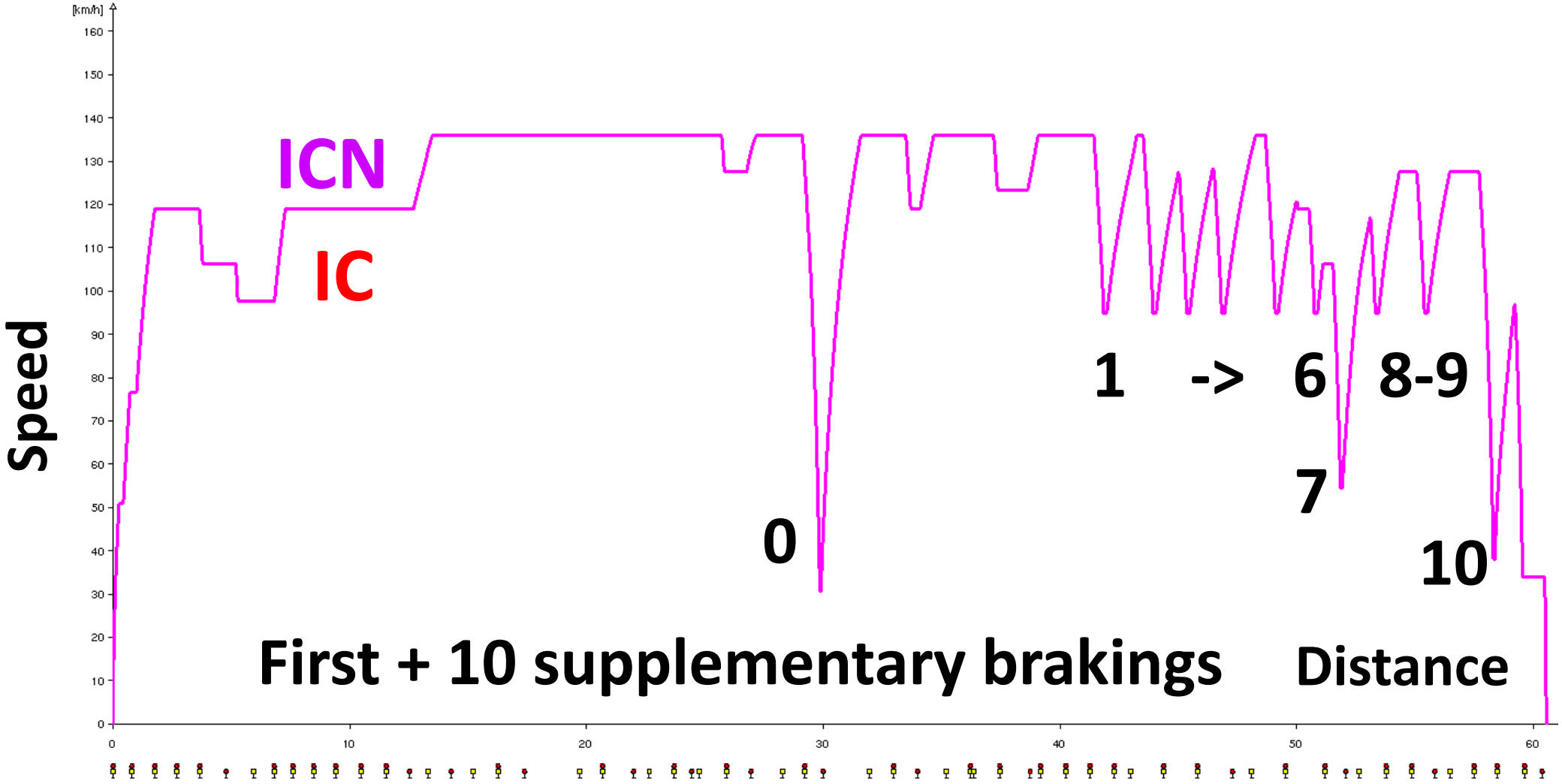
Speed profiles, number of intermediate stops, and mean distance between them: ICN(0, 60km), IC(0, 60km), IR(2, 20km), Freight(0, --), RE(7, 9km) , Freight-D(0, --)



Max Speed, BrakingWeightPercentage: ICN(160km/h, N180%), IC/IR(140km/h, R135%), Freight(100km/h, A115%), RE(140km/h, R135%), Freight-D(80km/h, D)

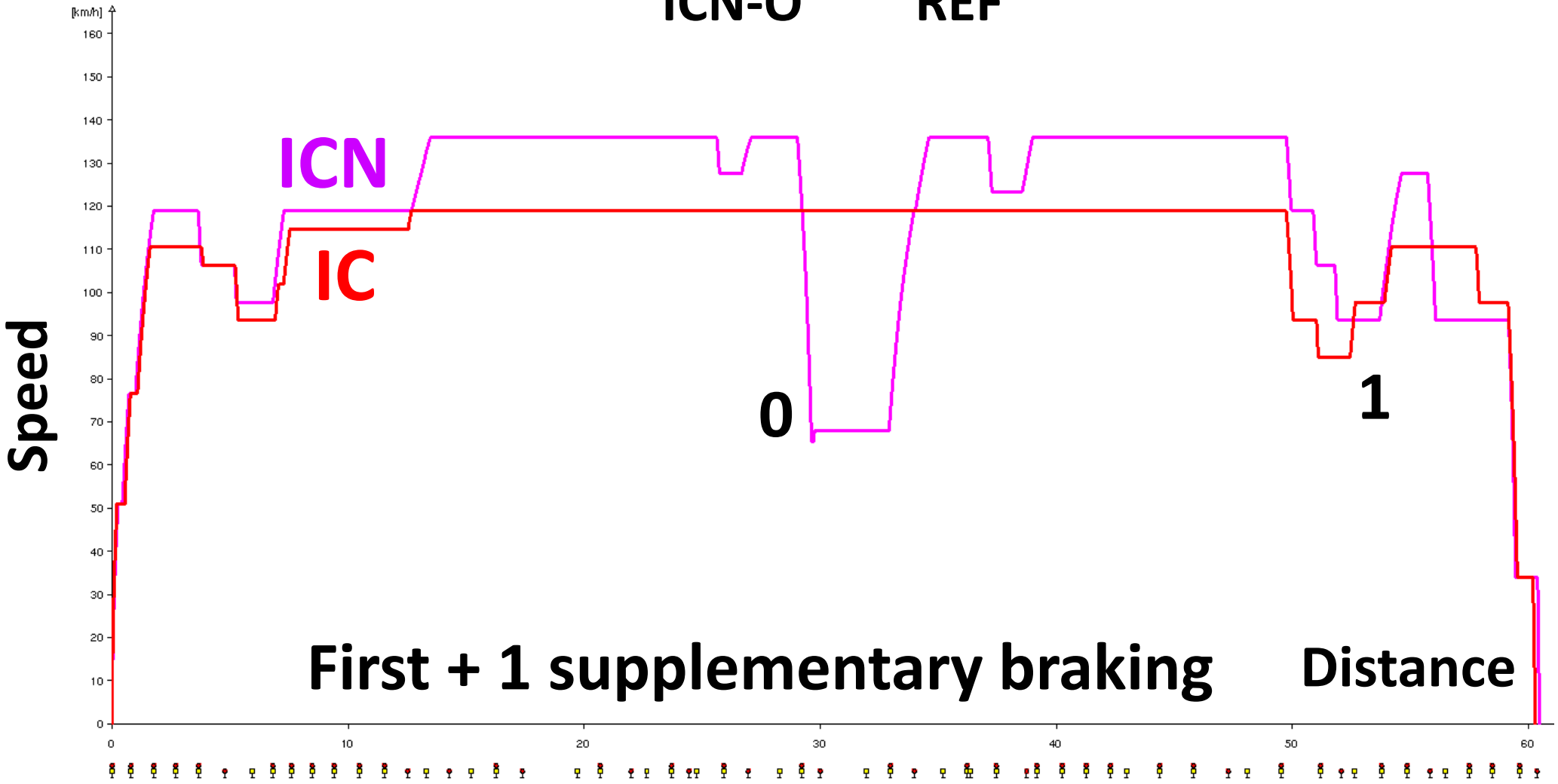


IC First, ICN "offensive"



IC First, ICN "no stress"

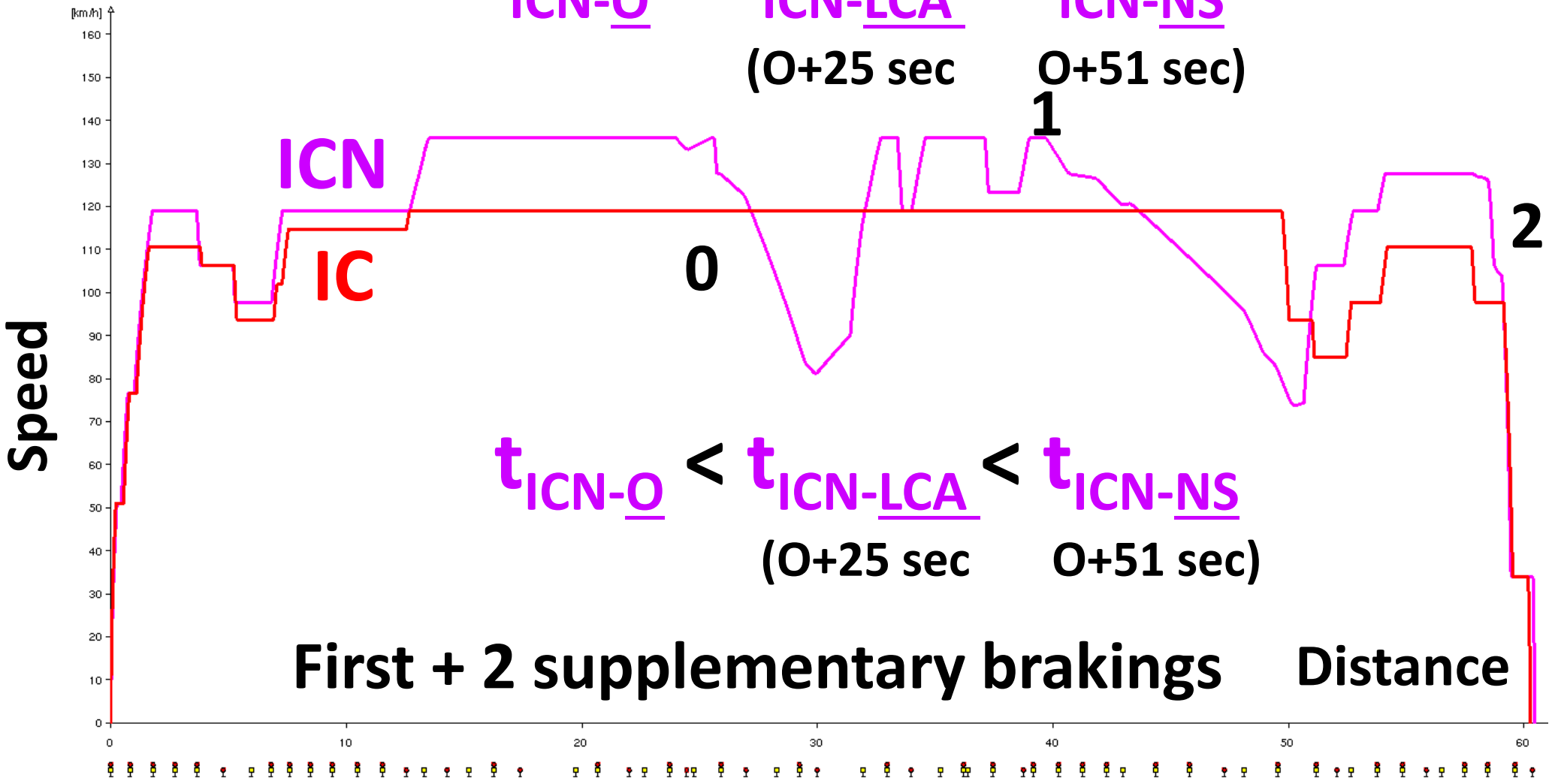
$t_{ICN-O} = t_{REF}$



IC First, ICN "LCA"

$t_{ICN-O} < t_{ICN-LCA} < t_{ICN-NS}$

(O+25 sec O+51 sec)

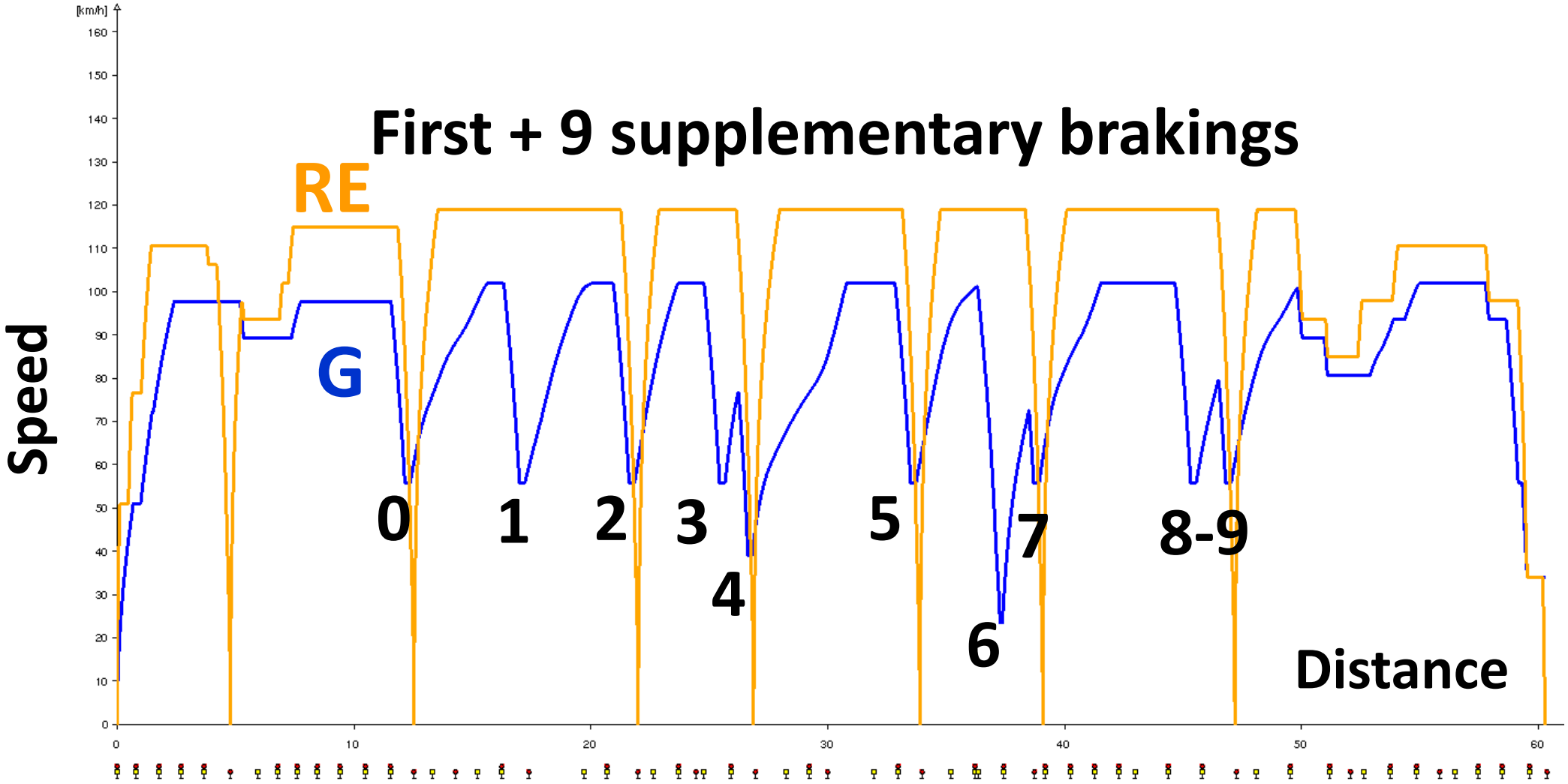


$t_{ICN-O} < t_{ICN-LCA} < t_{ICN-NS}$

(O+25 sec O+51 sec)

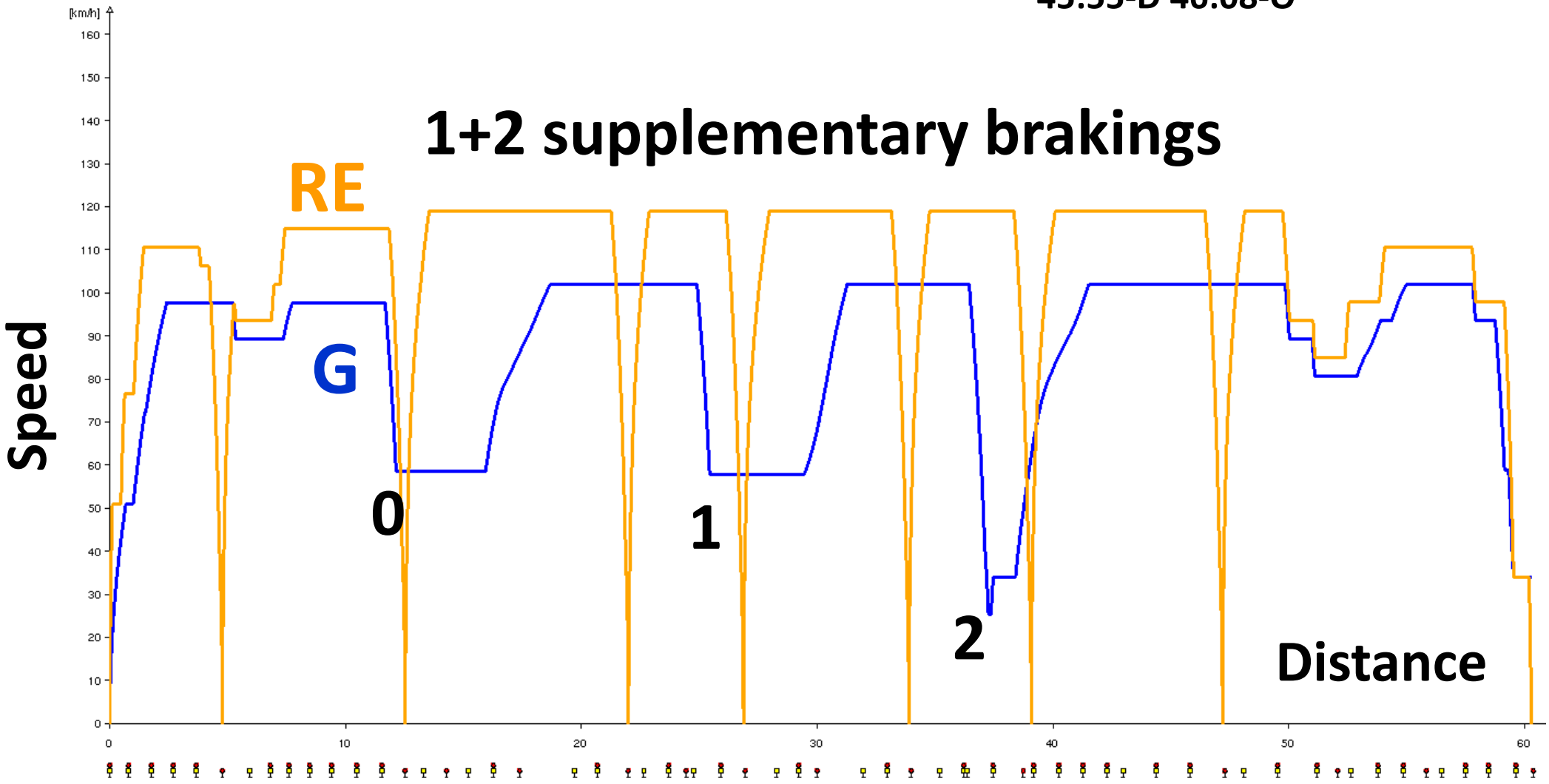
First + 2 supplementary brakings Distance

RE First, G "offensive"



RE First, G "no stress"

A115%-RE : 46:38LCA
45:55-D 46:08-O

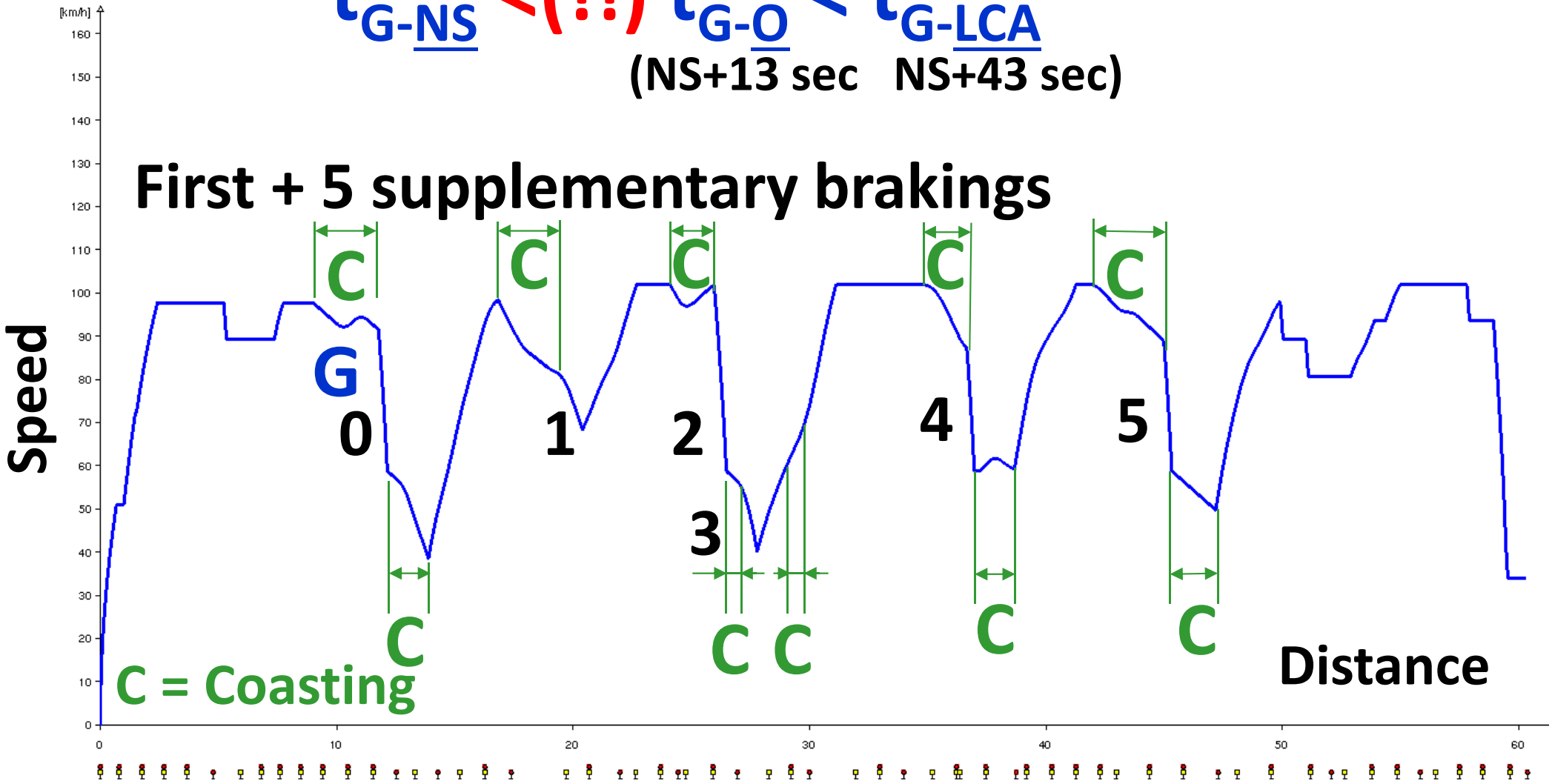


RE First, G "LCA"

A115%-RE : 46:38LCA
45:55-D 46:08-O

$t_{G\text{-}NS} <(!!) t_{G\text{-}O} < t_{G\text{-}LCA}$

(NS+13 sec NS+43 sec)



Last clear signal aspect →
Anticipation →
Energy savings, Less stress

Last clear signal aspect →
Driving style standardization →
Optimization of the capacity use ?

Thank you for your attention

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WEB: http://personnes.epfl.ch/daniel.emery

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