TRACK DESCRIPTION DATA BASE PRINCIPLES

1. OBJECT

This document gives an example of possible use of the data base to calculate the Most Restrictive Speed Profile.

The perimeter of the values and packets is voluntarily reduced in order to simplify the presentation of the calculations.

2. TECHNICAL ASSUMPTIONS

2.1. BUFFER OF THE TRACK DATABASE

The database, which contains the track events, is build from a buffer.

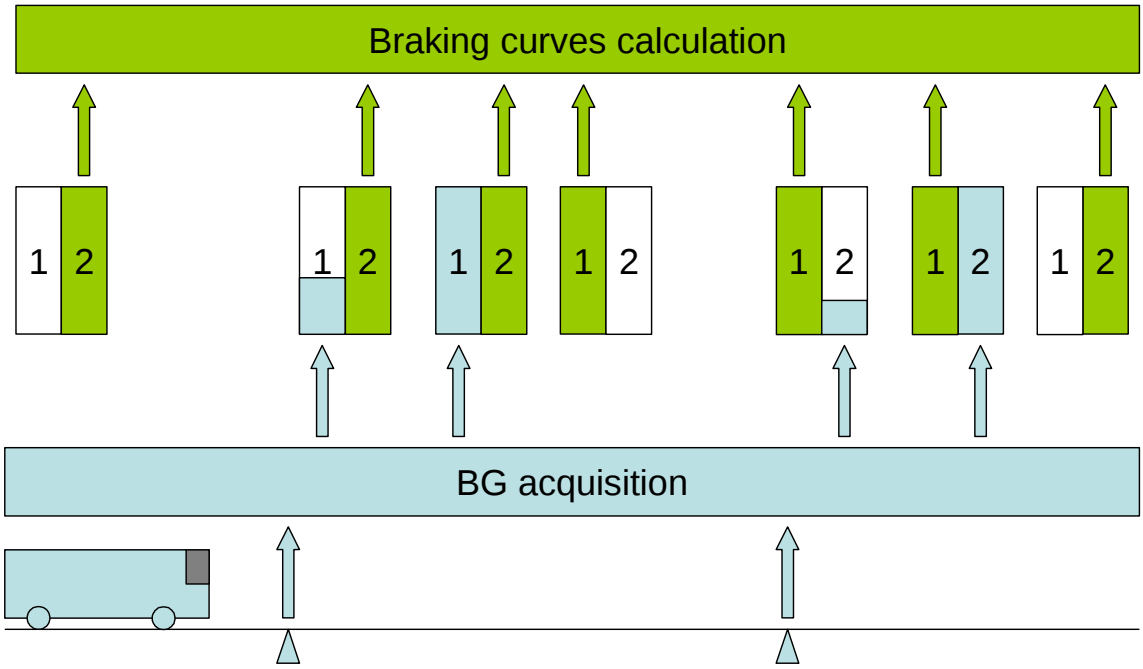
The length of the buffer is large enough to receive a complete MA description, for example, 20 km. It means a buffer of 20 km / 100m = 200 steps or 20 km / 10m = 2000 steps.

The buffer is initialized at Start of Mission, which is the reference 0m of the absolute position of the train. It means that the absolute position of the train, in the buffer, is not the real absolute position but the real absolute position modulo 20 km.Example, for a 100m step:

real	buffer		real	buffer
0 m	0		20000 m	0
100 m	100		20100 m	100
200 m	200		20200 m	200
300 m	300		20300 m	300
400 m	400		20400 m	400
500 m	500		20500 m	500
600 m	600		20600 m	600
700 m	700		20700 m	700
…	…	----->	…	…
19200 m	19200		39200 m	19200
19300 m	19300		39300 m	19300
19400 m	19400		39400 m	19400
19500 m	19500		39500 m	19500
19600 m	19600		39600 m	19600
19700 m	19700		39700 m	19700
19800 m	19800		39800 m	19800
19900 m	19900		39900 m	19900

The calculation needs two identical buffers

- one in use for the breaking curves calculation
- another one is empty and ready to receive data from a new BG. When the acquisition of the new data is finished, it becomes the reference buffer for the braking curves calculation.


Braking curves calculation
1
2
1
2
1
2
1
2
1
2
1
2
1
2
BG acquisition

2.2. INPUTS AND ACQUISITIONS

In order to calculate a simplified MRSP, we need the following packets: 15 (MA), 27(SSP), 65(TSR). And two data: the length of the train and the max Speed of the train.

Assumptions:

- The information is provided by BG only,
- NID_C (Country identifier) is not used => NID_LRBG id is limited to 14b
- A previous treatment was in charge of BG acquisition and supplied:
    - Two BG data: BG identifier (NID_BG) and absolute BG position in the train reference system (Dabs_BG),
    - Extracted packets information.
- Only valid packets are transmitted,
- Packets 15 and 27 are supplied together in a BG which becomes LRBG when overpassed
- Packet 65 is supplied alone, from another BG (which can not be used as LRBG)
- Max Speed at End of MA = 0 km/h

Transmitted inputs are:

2.3. LENGTH AND MAX SPEED OF THE TRAIN

L_Train = 100m

MaxSpeed_Train = 230 km/h

2.4. FIRST BALISE GROUP DATA

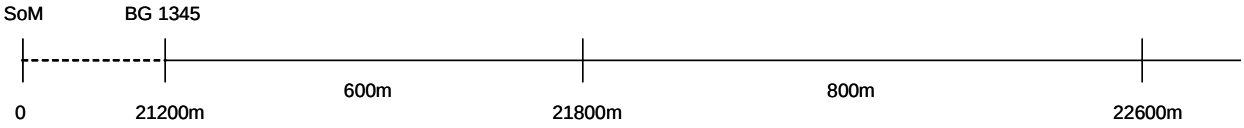
BG Header	NID_BG	1345		Integer 14b	
	Dabs BG	21200	m	Integer 32b fixed point 256	
Pkt 15	NID_PACKET	15		Integer 8b	
	Q_SCALE	2		Integer 2b	2 = 10m
	N_ITER	1		Integer 5b	
	L_SECTION (1)	60		Integer 15b	x Q_SCALE
	L_ENDSECTION	80		Integer 15b	x Q_SCALE
Pkt 27	NID_PACKET	27		Integer 8b	
	Q_SCALE	2		Integer 2b	2 = 10m
	D_STATIC	0		Integer 15b	x Q_SCALE
	V_STATIC	200	km/h	Integer 7b	
	N_ITER	3		Integer 5b	
	D_STATIC(1)	20		Integer 15b	x Q_SCALE
	V_STATIC(1)	240	km/h	Integer 7b	
	D_STATIC(2)	30		Integer 15b	x Q_SCALE
	V_STATIC(2)	220	km/h	Integer 7b	
	D_STATIC(2)	50		Integer 15b	x Q_SCALE
	V_STATIC(2)	180	km/h	Integer 7b	

How to read packet 15?

BG n° 1345 (NID_BG) is at 21200m (Dabs BG) from the Start of Mission train location

The given MA is built from to sections:

- the last section is 80 (L_ENDSECTION) x 10 (Q_SCALE) = 800 meter long
- there is one section before the last one (N_ITER), and the length of this section is 60 (L_SECTION (1)) x 10 (Q_SCALE) = 600 meter long

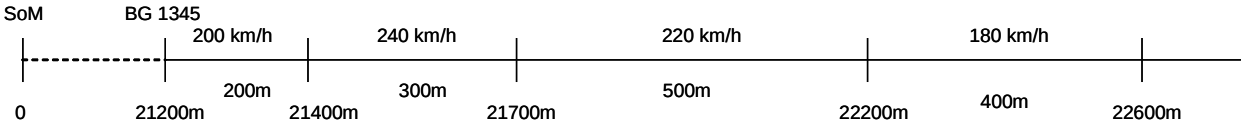


How to read packet 27?

A the beginning of the MA (D_STATIC = 0) the max speed is 220 km/h (V_STATIC)

After 20 (D_STATIC(1)) x 10m (Q_SCALE) = 200m, the max speed becomes 240 km/h (V_STATIC(1))

And so on…



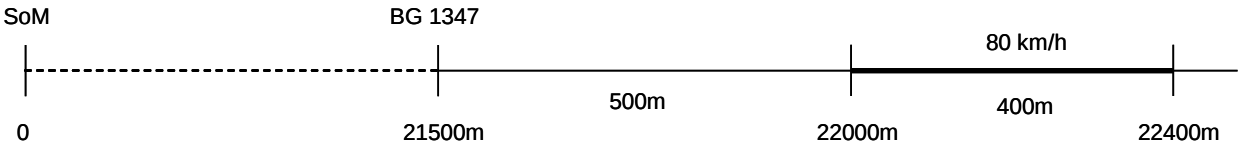
2.5. SECOND BALISE GROUP DATA

BG Header	NID_BG	1347	Integer 14b	
	Dabs BG	21500 m	Integer 32b fixed point 256	
Pkt 65	NID_PACKET	65	Integer 8b	
	Q_SCALE	2	Integer 2b	2 = 10m
	NID_TSR	22	Integer 8b	
	D_TSR	50	Integer 15b	x Q_SCALE
	L_TSR	30	Integer 15b	x Q_SCALE
	Q_FRONT	0	Integer 1b	Train lenght shall be taken in account
	V_TSR	80 km/h	Integer 7b	

How to read packet 65?

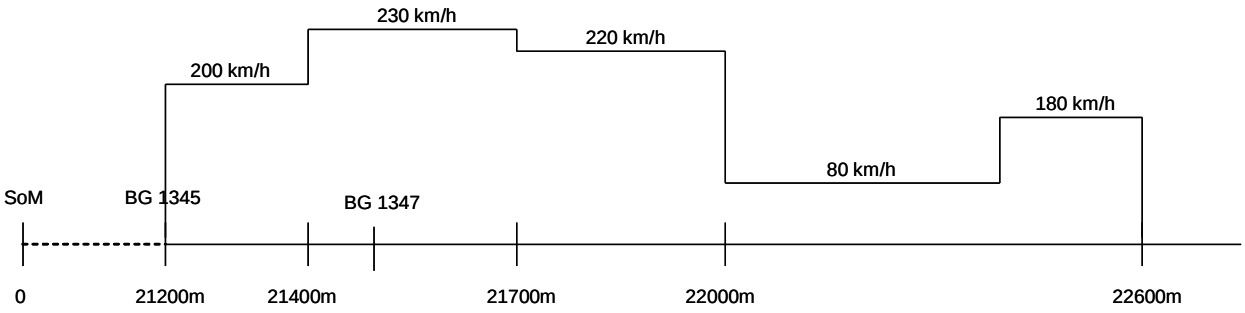
At a distance of 50 (D_TSR) x 10m (Q_SCALE) = 500m from the absolute position 21500m (D abs BG) of the BG n° 1347 (NID_BG), the train shall apply a maximum speed of 80 km/h (V_TSR) on 30 (L_TSR) x 10m (Q_SCALE) = 300m

The rear end of the train shall have leaved the complete speed reduction zone before acceleration. It is why a distance of 100m (L_Train) has to be added to L_TSR



2.6. RESULTING MRSP CURVE

What is needed at the end is the following MRSP curve:



3. MRSP CALCULATION

3.1. FIRST STEP: INITIALIZATION

During Start of Mission, database buffer and tables are initialized, as empty.

3.2. SECOND STEP: RECEPTION OF THE FIRST BG DATA

When received, data are homogenized and put in two tables: section table and SSP table.

Speed is converted in m/s (type = integer fixed point).

NIB BG (1345) and D Abs BG (21200) are memorized as LRBG Data.

D Abs shall take in account the size of the buffer (20000m) when introducing the data. Therefore it is not 21200, but 21200 modulo 20000 = 1200

Section table	
End flag	Length (m)
N	600
Y	800

SSP table		
End Flag	D (m)	Value m/s
N	0	55,56
N	200	66,67
N	300	61,11
Y	500	50,00

Then, section table is used to modify the data base buffer. For MRSP, it means:

1. introduce the max Speed of the train
2. introduce 0 km/ at the EOA place and takes the min values
3. introduce SSP values from LRBG Location to EOA and takes the min values

These values erase the previous section and SSP values.

4. introduce previous TSR values (in our case, there are none) and takes the min values

Previous TSR values shall be maintained.

3.3. THIRD STEP: RECEPTION OF THE SECOND BG DATA

Data are put in the TSR Table

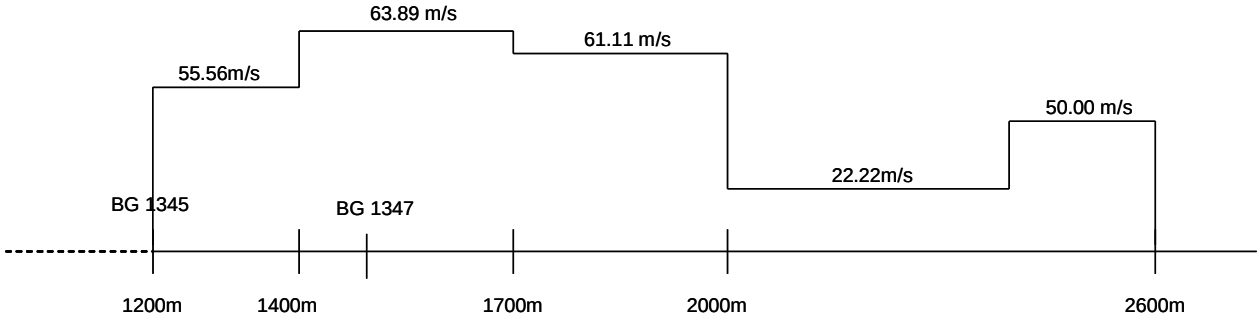
- Length of the train is added
- Speed is converted in m/s (type = integer fixed point)

TSR Table				
N°	D Abs (m)	D / BG (m)	Length (m)	Max speed (km/h)
22	1500	500	400	22,22

The buffer is modified in the same way as the previous BG (introduce the data and select the min values)

The introduced data and the final result are these one:

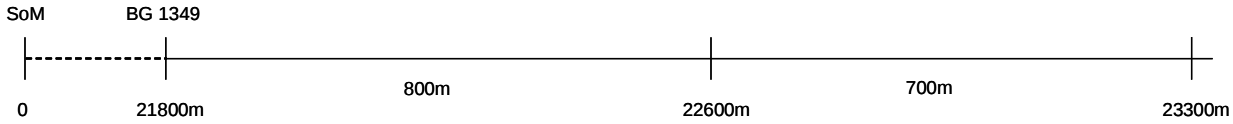
BG		EOA	Max Speed	SSP	TSR	MRSP (min)
	0	-	63.89	-	-	63.89
	100	-	63.89	-	-	63.89
	200	-	63.89	-	-	63.89
	300	-	63.89	-	-	63.89
	400	-	63.89	-	-	63.89
	500	-	63.89	-	-	63.89
	600	-	63.89	-	-	63.89
	700	-	63.89	-	-	63.89
	800	-	63.89	-	-	63.89
	900	-	63.89	-	-	63.89
	1000	-	63.89	-	-	63.89
	1100	-	63.89	-	-	63.89
1345	1200	-	63.89	55.56	-	55.56
	1300	-	63.89	55.56	-	55.56
	1400	-	63.89	66.67	-	63.89
1347	1500	-	63.89	66.67	-	63.89
	1600	-	63.89	66.67	-	63.89
	1700	-	63.89	61.11	-	61.11
	1800	-	63.89	61.11	-	61.11
	1900	-	63.89	61.11	-	61.11
	2000	-	63.89	61.11	22.22	22.22
	2100	-	63.89	61.11	22.22	22.22
	2200	-	63.89	50.00	22.22	22.22
	2300	-	63.89	50.00	22.22	22.22
	2400	-	63.89	50.00	-	50.00
	2500	-	63.89	50.00	-	50.00
	2600	0	63.89	50.00	-	0
	2700	-	63.89	-	-	63.89
	2800	-	63.89	-	-	63.89
	2900	-	63.89	-	-	63.89
	3000	-	63.89	-	-	63.89

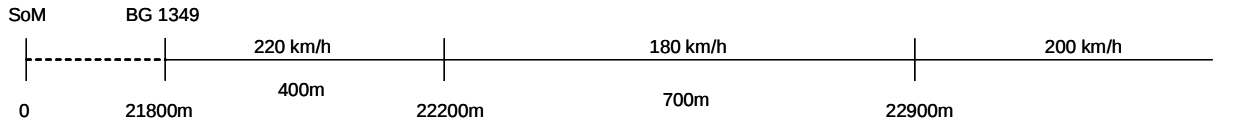


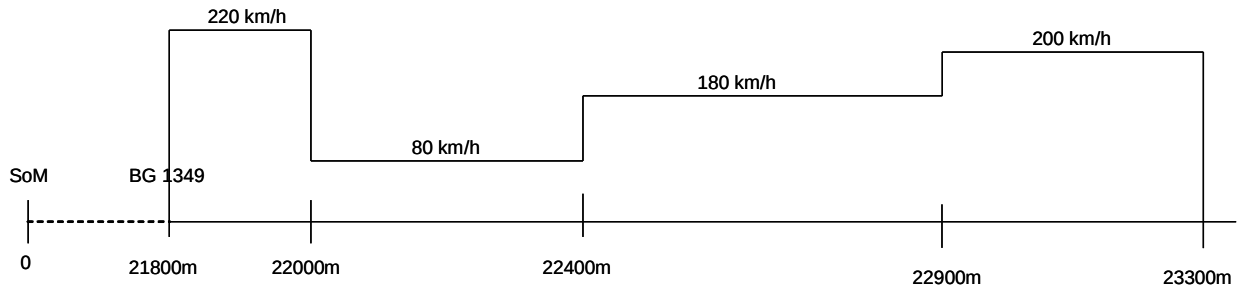
3.4. NEXT BALISE GROUP

When the train passes over a new LRBG, the MA and SSP information is updated but the TSR information is written out again:

BG	NID_BG	1349	
Header	Dabs BG	21800	m
Pkt 15	NID_PACKET	15	
	Q_SCALE	2	
	N_ITER	1	
	L_SECTION (1)	80	
	L_ENDSECTION	70	
Pkt 27	NID_PACKET	27	
	Q_SCALE	2	
	D_STATIC	0	
	V_STATIC	220	km/h
	N_ITER	3	
	D_STATIC(1)	40	
	V_STATIC(1)	180	km/h
	D_STATIC(2)	70	
	V_STATIC(2)	220	km/h







BG		EOA	Max Speed	SSP	TSR	MRSP (min)
1345	1200	-	63.89	55.56	-	55.56
	1300	-	63.89	55.56	-	55.56
	1400	-	63.89	66.67	-	63.89
1347	1500	-	63.89	66.67	-	63.89
	1600	-	63.89	66.67	-	63.89
	1700	-	63.89	61.11	-	61.11
1349	1800	-	63.89	61.11	-	61.11
	1900	-	63.89	61.11	-	61.11
	2000	-	63.89	61.11	22.22	22.22
	2100	-	63.89	61.11	22.22	22.22
	2200	-	63.89	50.00	22.22	22.22
	2300	-	63.89	50.00	22.22	22.22
	2400	-	63.89	50.00	-	50.00
	2500	-	63.89	50.00	-	50.00
	2600	-	63.89	50.00	-	50.00
	2700	-	63.89	50.00	-	50.00
	2800	-	63.89	50.00	-	50.00
	2900	-	63.89	55.56	-	55.56
	3000	-	63.89	55.56	-	55.56
	3100	-	63.89	55.56	-	55.56
	3200	-	63.89	55.56	-	55.56
	3300	0	63.89	-	-	0
	3400	-	63.89	-	-	63.89
	3500	-	63.89	-	-	63.89
	3600	-	63.89	-	-	63.89
	3700	-	63.89	-	-	63.89
	3800	-	63.89	-	-	63.89
	3900	-	63.89	-	-	63.89
	4000	-	63.89	-	-	63.89
	4100	-	63.89	-	-	63.89
	4200	-	63.89	-	-	63.89