ALL4TEC

TRAIN POSITION

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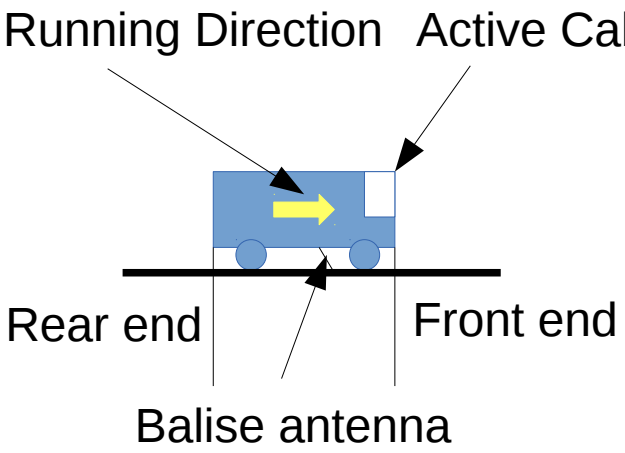
TRAIN POSITION INFORMATION

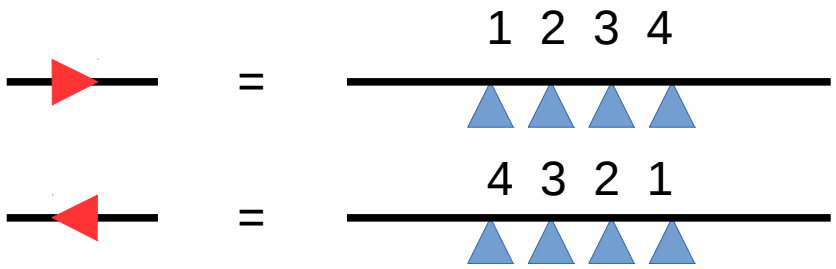
The Train Position information defines the position of the train front in relation to a balise group, which is called LRBG (the Last Relevant Balise Group). It includes:

* The estimated train front end position, defined by the estimated distance between the LRBG and the front end of the train
* The train position confidence interval
* Directional train position information in reference to the balise group orientation of the LRBG, regarding:
    - the position of the train front end (nominal or reverse side of the LRBG)
    - the train orientation
    - the train running direction
* A list of LRBGs, which may alternatively be used by trackside for referencing location dependent information

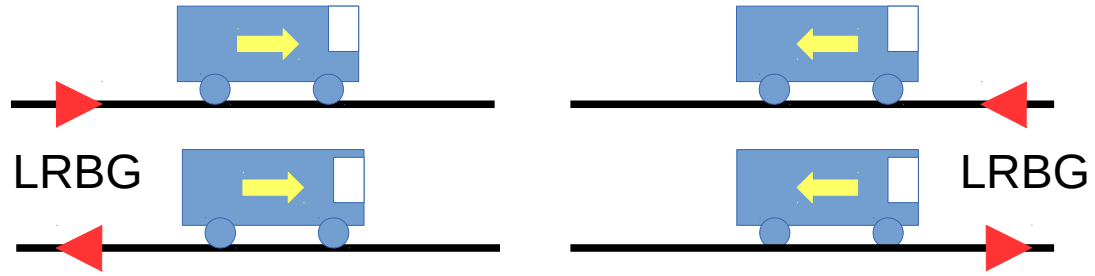
(SRS.3.6.1.3)

DIRECTIONAL TRAIN POSITION INFORMATION (1/2)



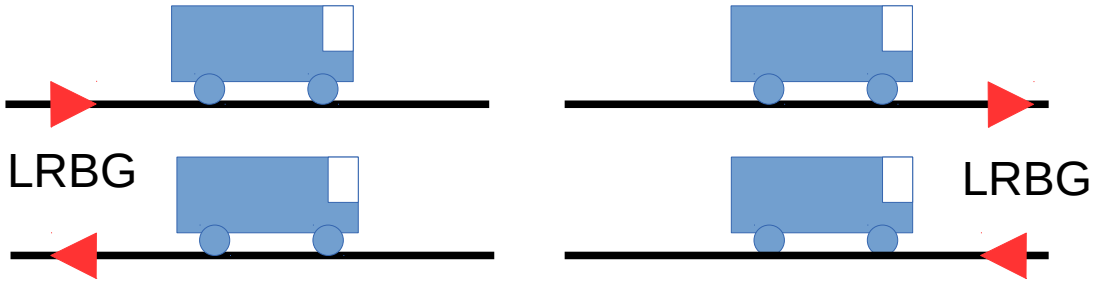


BG orientation



Running Direction = normal

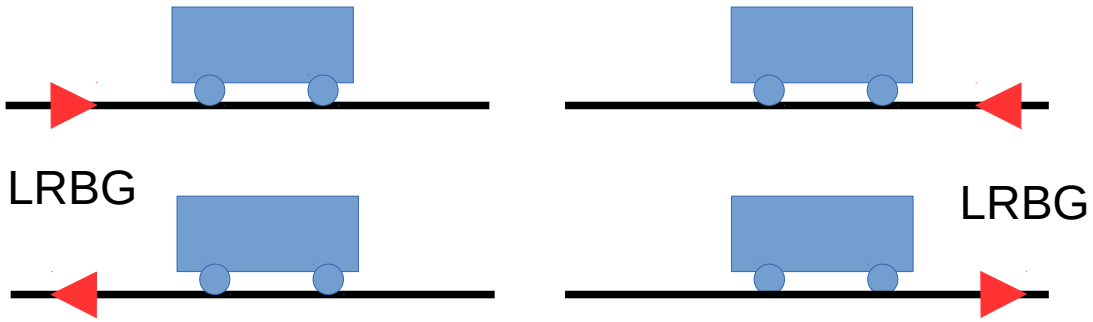
Running Direction = reverse



Train Direction = normal

Train Direction = reverse

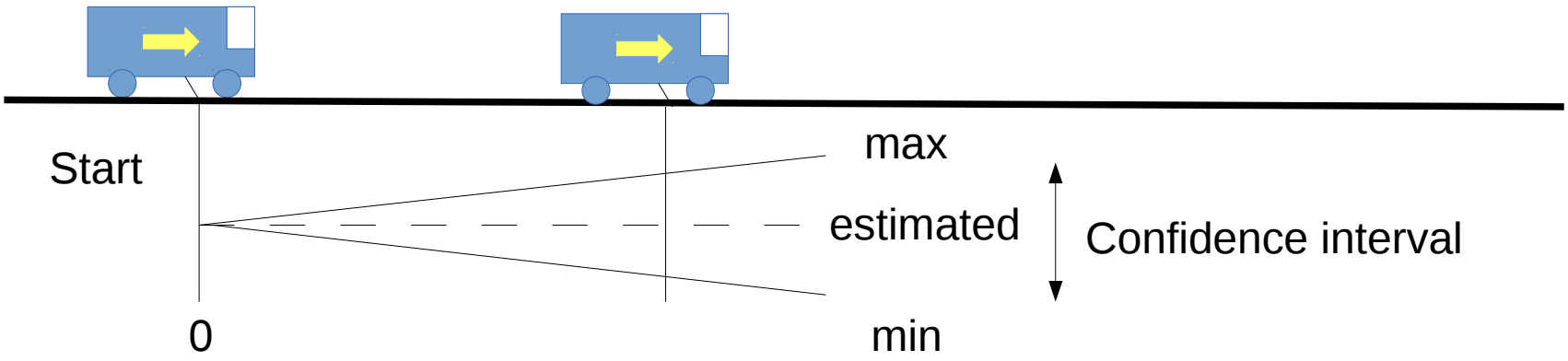
DIRECTIONAL TRAIN POSITION INFORMATION (2/2)



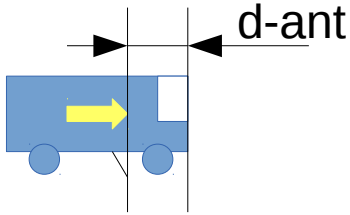
Train position = normal

Train position = reverse

ODOMETRY DEFINITIONS (1/2)

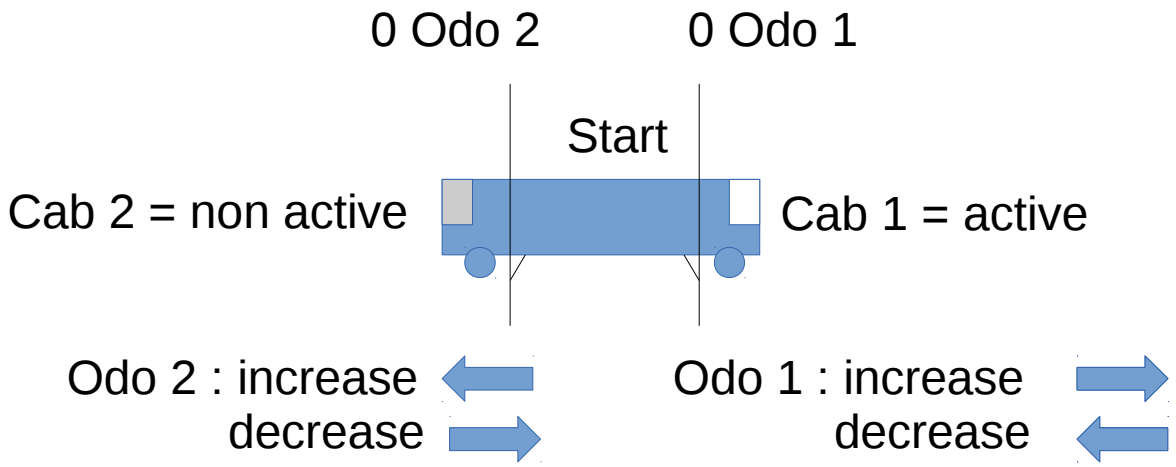


Max, estimated and min values are given by odometry
The confidence interval shall be < 5 %
Odometry calculates these values each 100ms (about)
N.B.: the confidence interval always increases as the train moves, forward OR backward



d-ant = distance between the front end and the balise antenna (about 3m)

ODOMETRY DEFINITIONS (2/2)

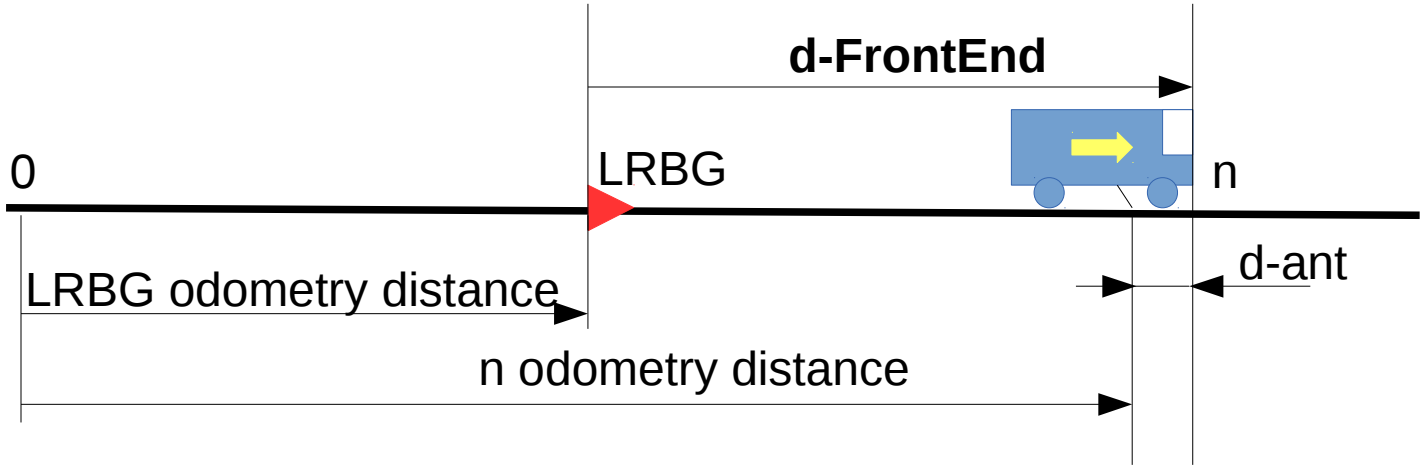


Generally, a train has two OBU and two odometries, one for each cab

Only one cab is active but the two odometries always work : one increases and the other decreases. So, if the active cab changes, the location is preserved and the reference (0 odo) automatically changes

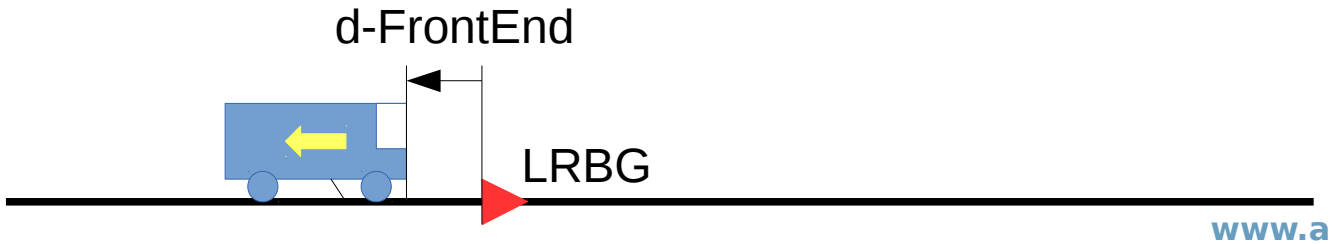
SIMPLIFIED LOCALISATION

To localize a train,two data are needed:
- LRBG (Last Relevant Balise Group), whose localisation is known
- d-FrontEnd: distance between the train front end and the LRBG
  This value is calculated with odometry information



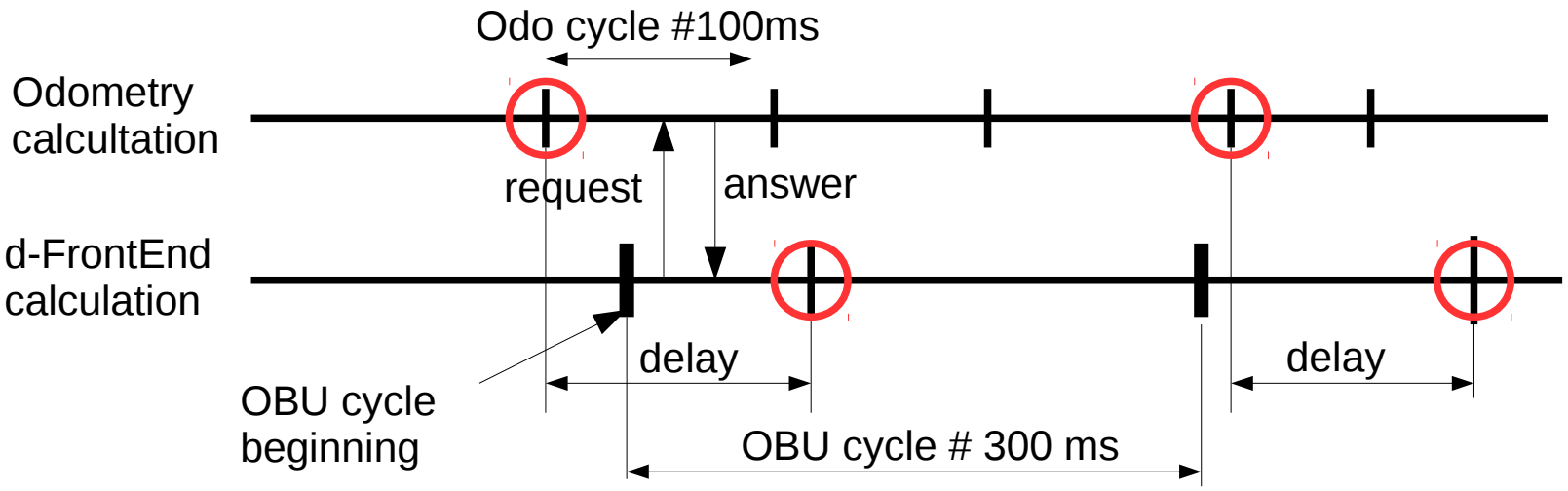
d-FrontEnd = n odometry distance – LRBG odometry distance + d-ant

NB : if the train goes backward, this value can be negative



TIME CYCLE CORRECTION

The OBU cycle is about 300ms and the odometry one is about 100ms
A timer distributes the same time to the OBU, the odometry and balise antenna system together
At its cycle beginning, the OBU asks odometry a set of refreshed data to calculate the FrontEnd position, and the odometry replies with a time-stamped information
So, the calculation has to take into account the distance traveled by the train during the delay between both the last odometry information time stamp and the Calculation time stamp itself

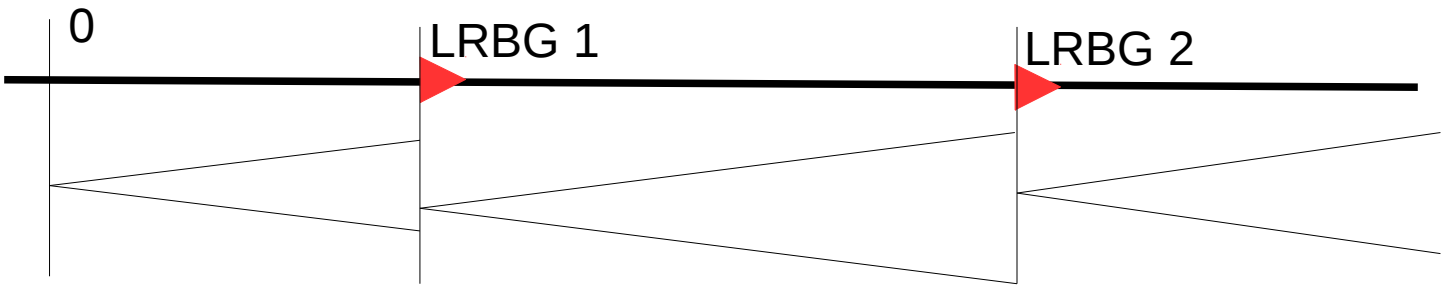


Estimated d-frontend = estimated n odometry distance – LRBG odometry distance + d-ant + (delay x current train speed)

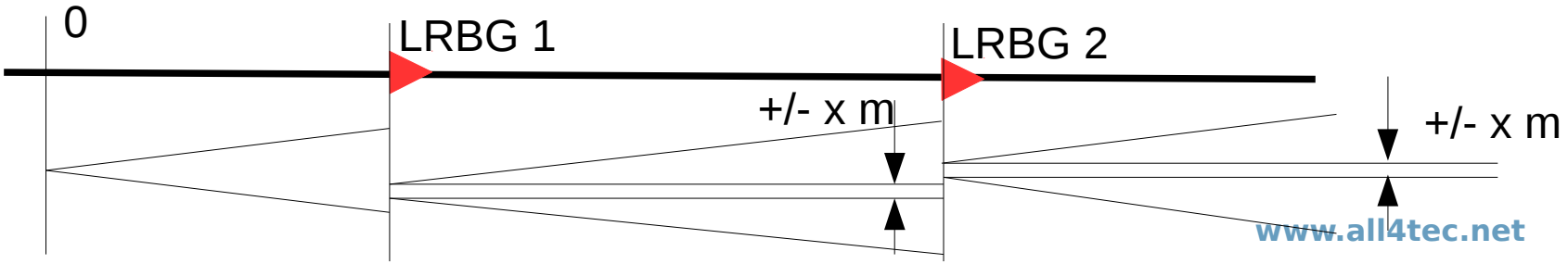
NB : at 350 km/h, the distance traveled by the train during a time cycle (300ms) is about 30m. So the corrective values are not insignificant

CONFIDENCE INTERVAL (1/1)

As the train passes over a new LRBG, the confidence interval can be reset, because the localisation of each LRBG is known with accuracy



So, as the LRBG changes, the OBU shall inform the odometry and this one shall reset the confidence interval
But this reset can not be 0 because there always remain some uncertainties:
- uncertainty of physical balise position
- uncertainty of antenna measurement
- (delay between antenna detection and consideration by OBU) x train speed
The sum of these uncertainties shall be < +/- x m. x is given by Q_LOCACC or a national value



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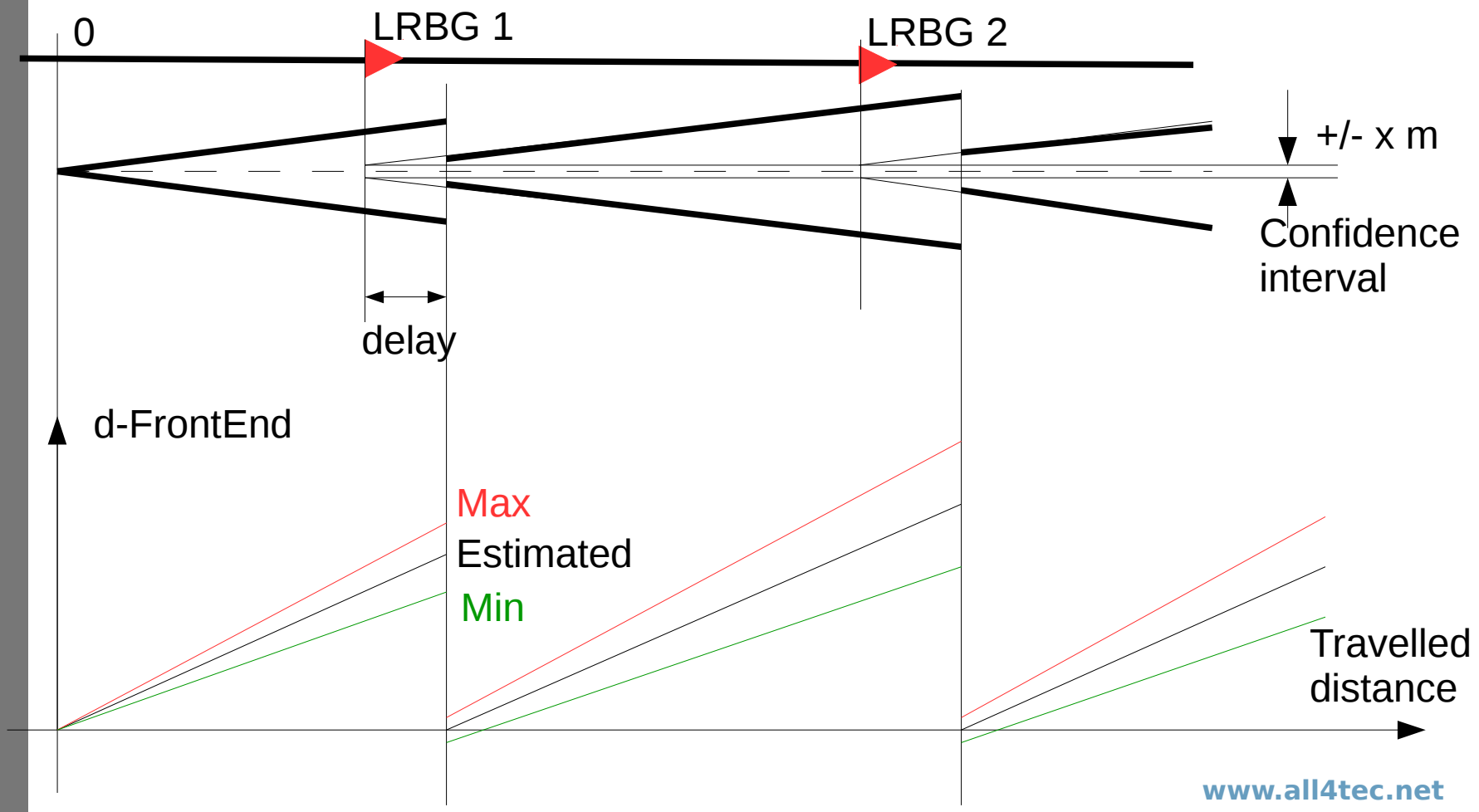
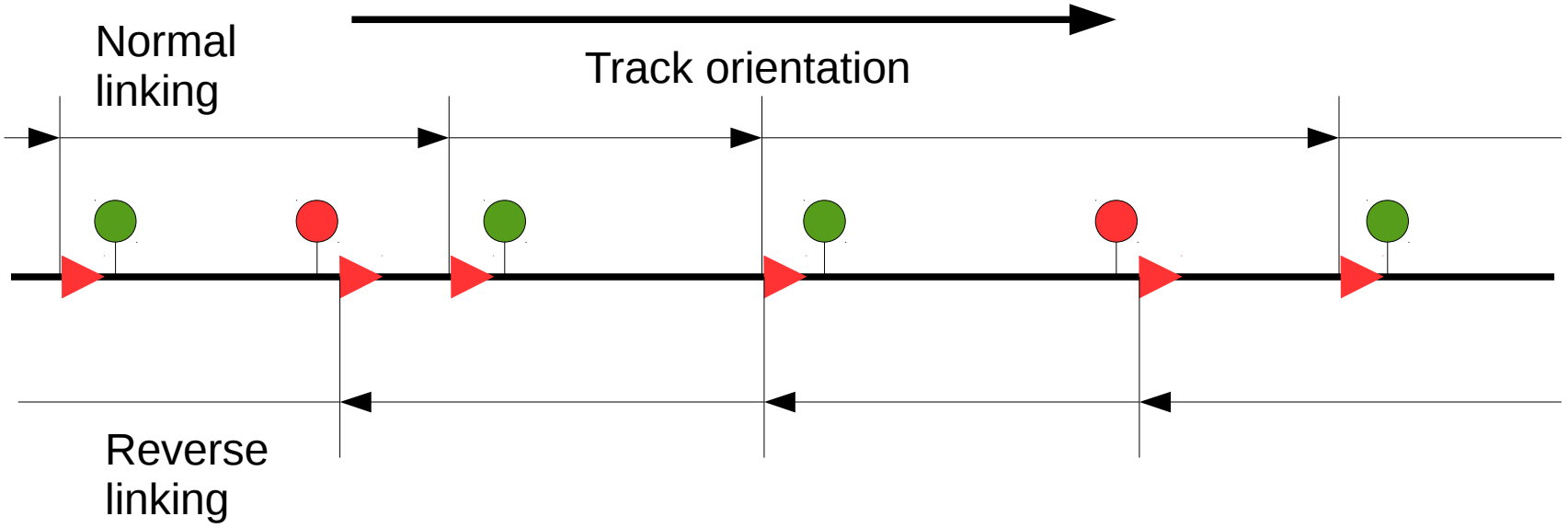
CONFIDENCE INTERVAL (2/2)

Last correction :
The delay between the LRBG pass over and the reset of the odometry values by OBU shall be taken into account

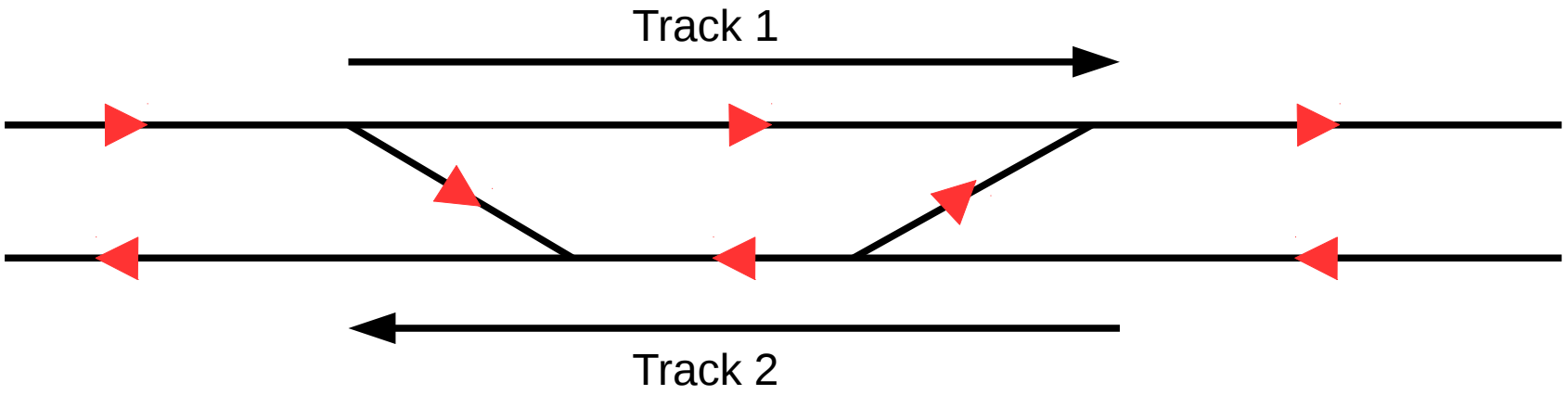


BALISE GROUP ORIENTATION

Balise groups are always oriented in the track normal direction
In one track there are both two linked systems: normal and reverse
A BG can be used for normal and reverse linking



BALISE GROUP ORIENTATION

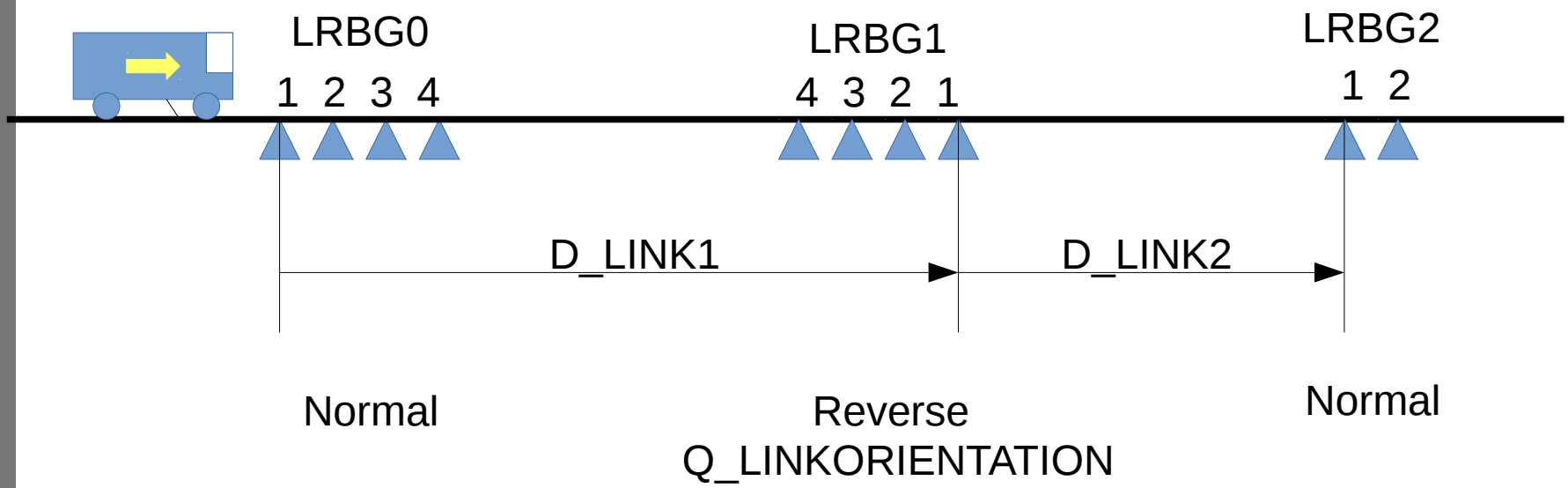


In front of a point, the system needs a switchable balise to give the appropriate linking, according to the switch point position

N.B. It is also possible to put the two linkings in a non switchable balise: the train opens an acquisition window for each linking but only one is present and can be read

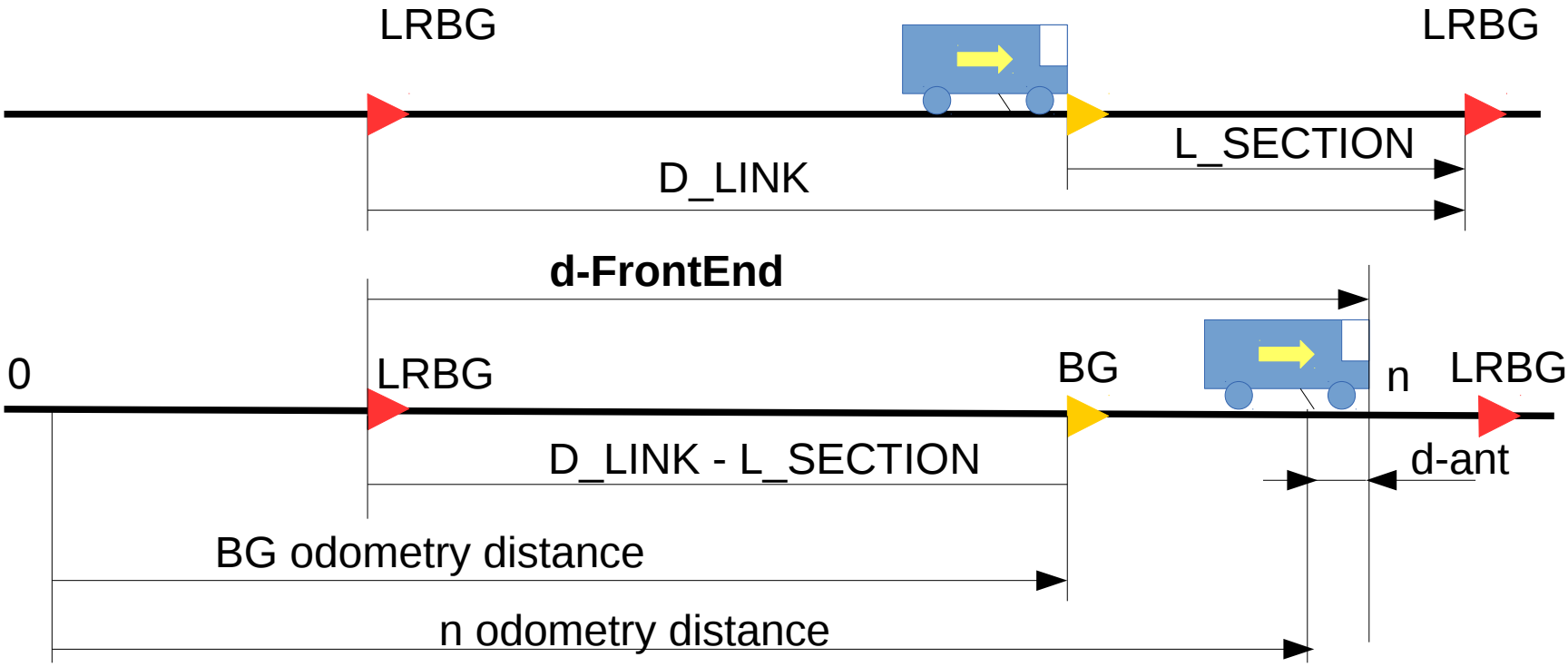
LINKED BALISE GROUP

Only linked BG are used as LRBG
A linked balise group is announced by the previous linked BG, in a packet 5
The transmitted linked BG table contains information for the next 4 or 5 BG:
- D_LINK: distance between linked BG (balise n°1)
- NID_BG: BG Number
- Q_LINKORIENTATION: BG orientation (seen from the current LRBG)
- Q_LINKREACTION: what shall the train do if it does not find the BG
- Q_LOCACC: accuracy of the balise location



REPOSITIONING (1/2)

If the system needs a good location accuracy (to enter a new domain for example), it is possible to command a repositioning with a « normal » BG
A packet 16 gives the L_SECTION, e.g. the distance between the next linked BG and the current BG



d-FrontEnd = n odometry distance – BG odometry distance
+ d-ant + (D_LINK - L_SECTION)

REPOSITIONING (2/2)

Accuracy value can be reset at repositioning place in the same way a LRBG place