Konkan Railway, India
Presents

Anti-Collision Device (ACD) Network

(Raksha Kavach™)

… A Train Collision Prevention System (TCPS)

Train Collisions - A 'Challenge' Accepted

- August 1999, **Head-on** Collision at 'Gaisal' –

  300 dead

- Konkan Railway accepted the challenge –

  Railways could not allow another life to be lost in a Collision, routinely classified as a 'human errors or limitations' and 'equipment failures'

Train Collisions - A ‘Challenge’ Accepted

Based on ‘Radio communication’, ‘Microprocessors’ and ‘Global Positioning System (GPS)’ technology, a Team of Konkan Railway in **90** days produced a prototype of Anti-Collision Device (ACD) which, when mounted on two approaching trains, would enable them to assess accurately each other’s course and initiate an ‘automatic’ braking action, in case they were perceived to be on ‘collision risk’

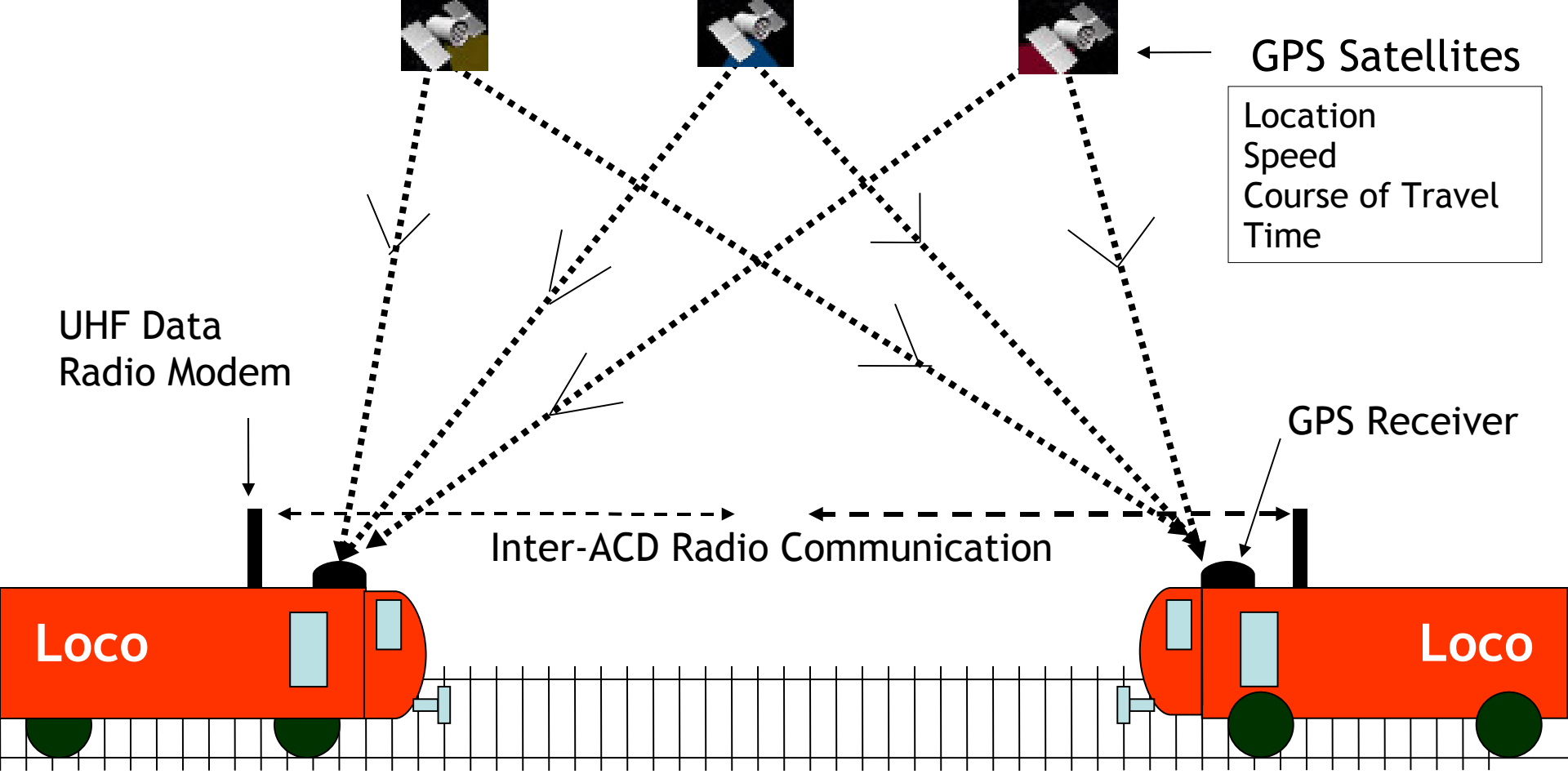
‘ACD’ – A Solution against ‘Collision’ found…

- **Anti-Collision Device (ACD)** – A KRCL ‘**Patent**’
- Unique features – **Prevents in a ‘mid-section’**
  - ‘**Head-on**’ Collisions
  - ‘**Side**’ Collisions
  - ‘**Rear-end**’ Collisions
  - & ++++
- **No other Technology in the World supports above features**

ACD - Pilot Project, Northeast Frontier Rly, India Commissioned by Indian Rlys in June 2007

Route Kms = 1760, Stations = 202

1	**Fixed ACDs** – Station ACD, Level Crossing ACD, ACD Repeater, etc.	**578**
2	**Mobile ACDs** – Loco ACD	**567**
	Guard ACD (Passenger)	**82**
	Guard ACD (Freight)	**133**
	Total	**1360**

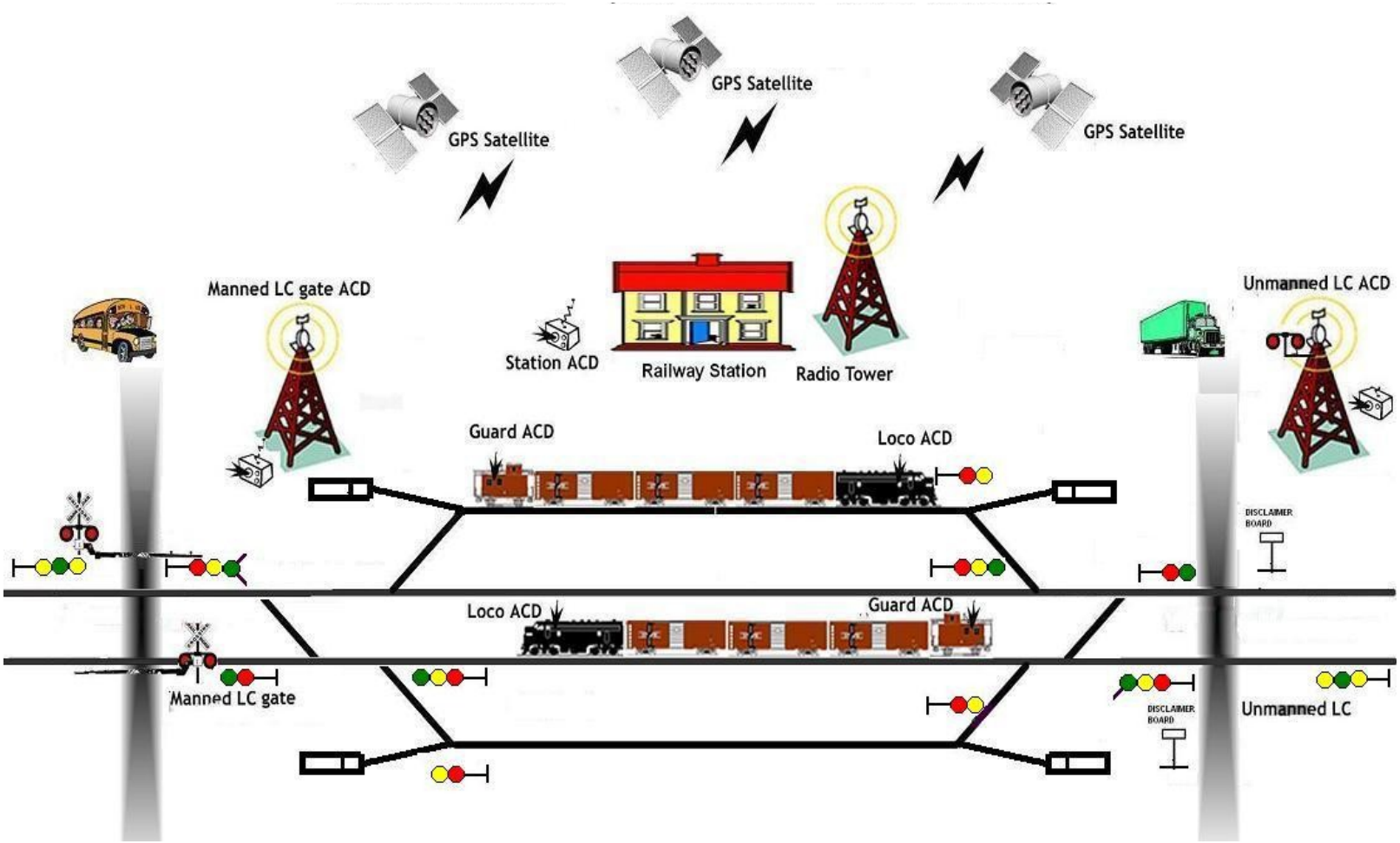


Working of "on-board" ACDs

Receive inputs from satellites, communicate with each other using radio modems & use intelligence to act

– To prevent 'dangerous' Collisions

‘ACD Network’(Raksha Kavach™) - An Overview



ACD Network … *A Train Collision Prevention System (TCPS)*

Salient Features - What ACD CAN DO

- Detection & Prevention of Head-on, Rear-end and Side Collisions – A UNIQUE feature even when a train is not protected by a signal, as in a block section
- Detection & generation of Train Parting / Jumbling - Consequently bringing any approaching train on the adjoining line to a dead stop
- 'Train Approach' Warning for road users at Level Crossings both manned and unmanned - In addition, at manned non-interlocked level crossings, reducing the train speed to 30 Kmph in case the gate is detected in 'open' condition through Gate ACD

Salient Features - What ACD CAN DO_

- Detection of fouling and prevention of collision due to fouling - Except when a Train on main line overshoots the 'Fouling Mark'
- Station Approach Warning to Drivers - Can result in saving of manpower for deployment of detonators during foggy weather, provided 100% coverage of ACD fitted trains is available on the concerned ACD route

Salient Features - What ACD CAN DO_

- Speed limit imposition - Based on 'preset' conditions in Functional Requirements Specification (FRS) of ACD
- Manual SOS functionality available for Drivers, Guards and Station Masters - To bring all trains to a halt within a radial distance of 3 Kms, in emergencies
- Auto Brake Test – Generating braking characteristics for a Train 'without manual feeding' of data of coaches / load - A UNIQUE feature as train characteristics are required to be fed 'manually' in all other systems in the world

Efficacy of ACD Network - Analysed for Indian Rlys

- Analysis of 'preventable' and 'non-preventable' collisions by 'Indian Railways' concluded that out of total of **'128 train collisions'** that took place during the five years period (from **April 1997 to January 2002**), about 82% cases were preventable by ACD system
- The balance **18%** of the collisions were 'non-preventable' in any case, due to various reasons like failure of brake power of train, inadequate reaction time, insufficient braking distance, etc.

ACD Network CAN NOT Prevent a Train Collision when…

- Other train is a 'NON' ACD Train – ACD functions by reacting to another ACD, as such if one of the two trains is a non-ACD train, the protection against collision will be missing
- 'Adequate' braking distance at that speed is not available when a 'dangerous' collision-like situation arises suddenly – However, severity of the collision would be reduced as a function of the reaction time
- Train derails and its wagons/coaches dash with another Train, already on 'adjacent' track – No reaction time situation
- 'Failure' of brake power of the Locomotive/train
- Rolling backward/forward of a 'Stabled load'

‘ACD Network’ (Raksha Kavach™) - An Overview

A **‘Non-Signaled’** system providing an **‘Additional layer of Safety’** in Train Operations to prevent ‘dangerous’ Train Collisions, caused due to **‘Human Errors or limitations’ and ‘equipment failures’**

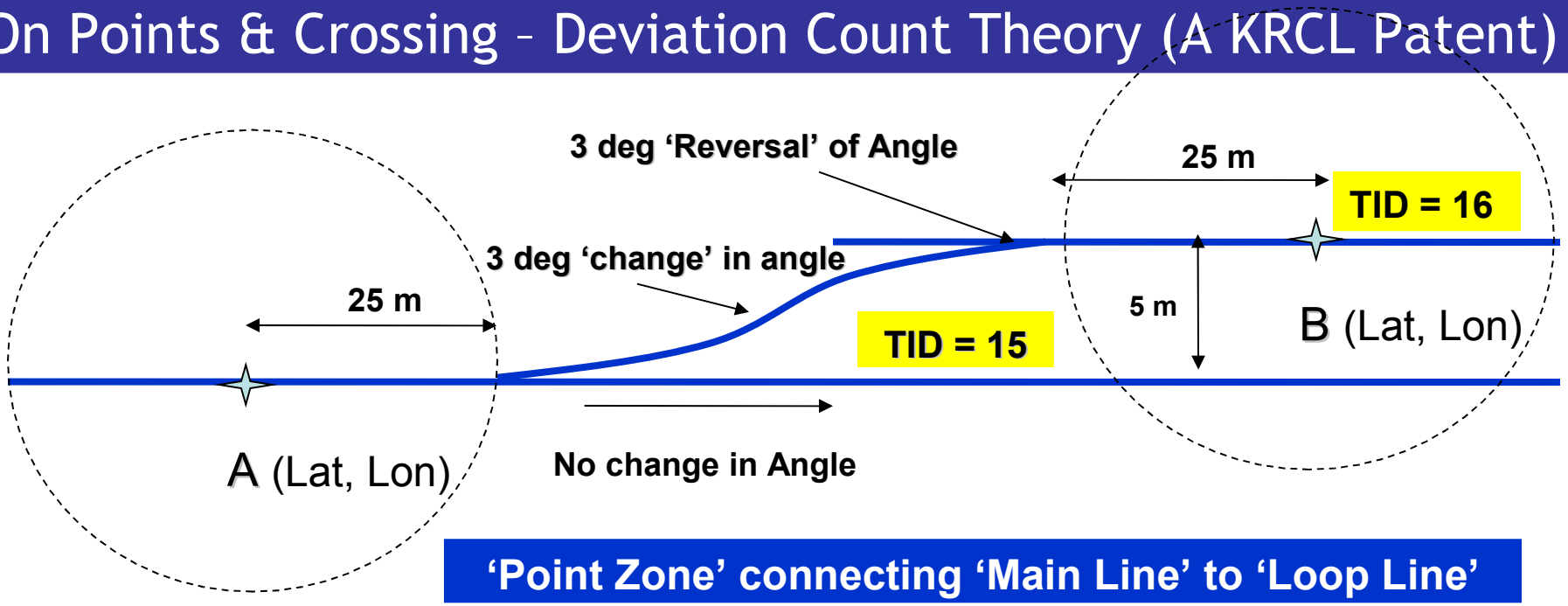
‘ACD Network’ (Raksha Kavach™) - Technology

- A Network of ‘on-board’ (Locomotive and Guard) and ‘track-side’ (Station, Level Crossing, Locoshed, Repeater and Sensor-based) ACDs that work on the principle of ‘**Distributed Control Systems**’
- ACDs interact en-route with each other through radio communication **within a radial range of 3 Kms**
- On-board computers use input from GPS system for determination of **Train location, Speed, Course of travel and Time**

‘ACD Network’ (Raksha Kavach™) - Technology

- Mobile and stationary components of ACD Network exchange information and take decisions based on **train working rules embedded in software** to apply brakes automatically without any input from the users
- If **2 ACDs** are deemed to be at a **risk of collision**, the ACD system activates **automatic braking operation** to prevent collisions
- Loco ACD is designed to interface with **various types of braking systems** of Locomotives

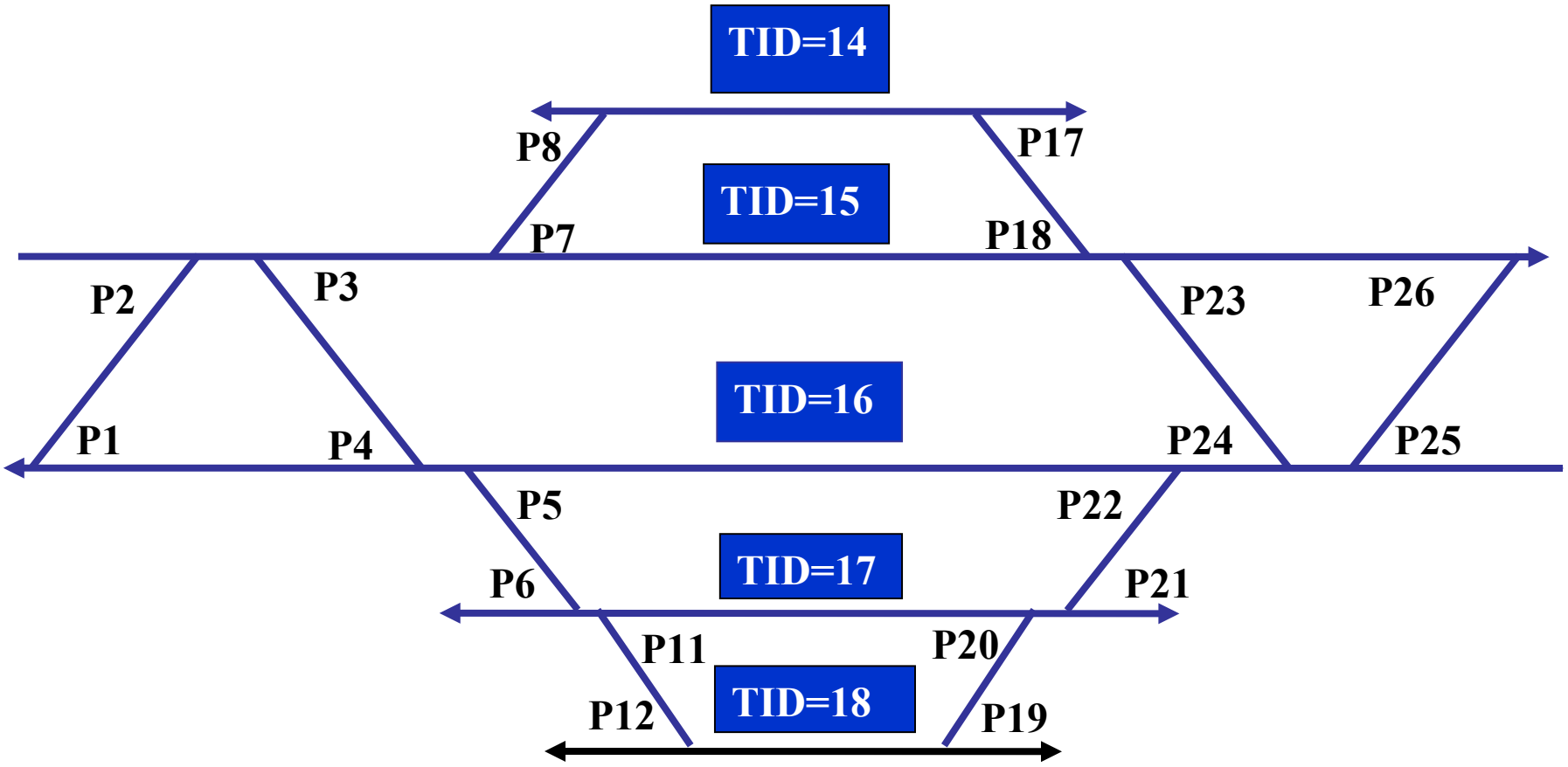
Deduction of Change in 'Track-ID' by Train bound ACDs On Points & Crossing – Deviation Count Theory (A KRCL Patent)



- 'Point Zone' is defined between 'A' and 'B' on the track
- Even with a location 'inaccuracy' of ± 25 metres, the Loco/Guard ACD will not miss the beginning of 'Point Zone'
- Inside the 'Point Zone, 'reversal' of Angle of travel decides the change in 'Track-ID' of Loco ACD and Guard ACD, as the case may be

ACD Network mainly takes 'Track-ID' based decisions

Station Track-ID (TID) Plan (Stored in a 'Station ACD')

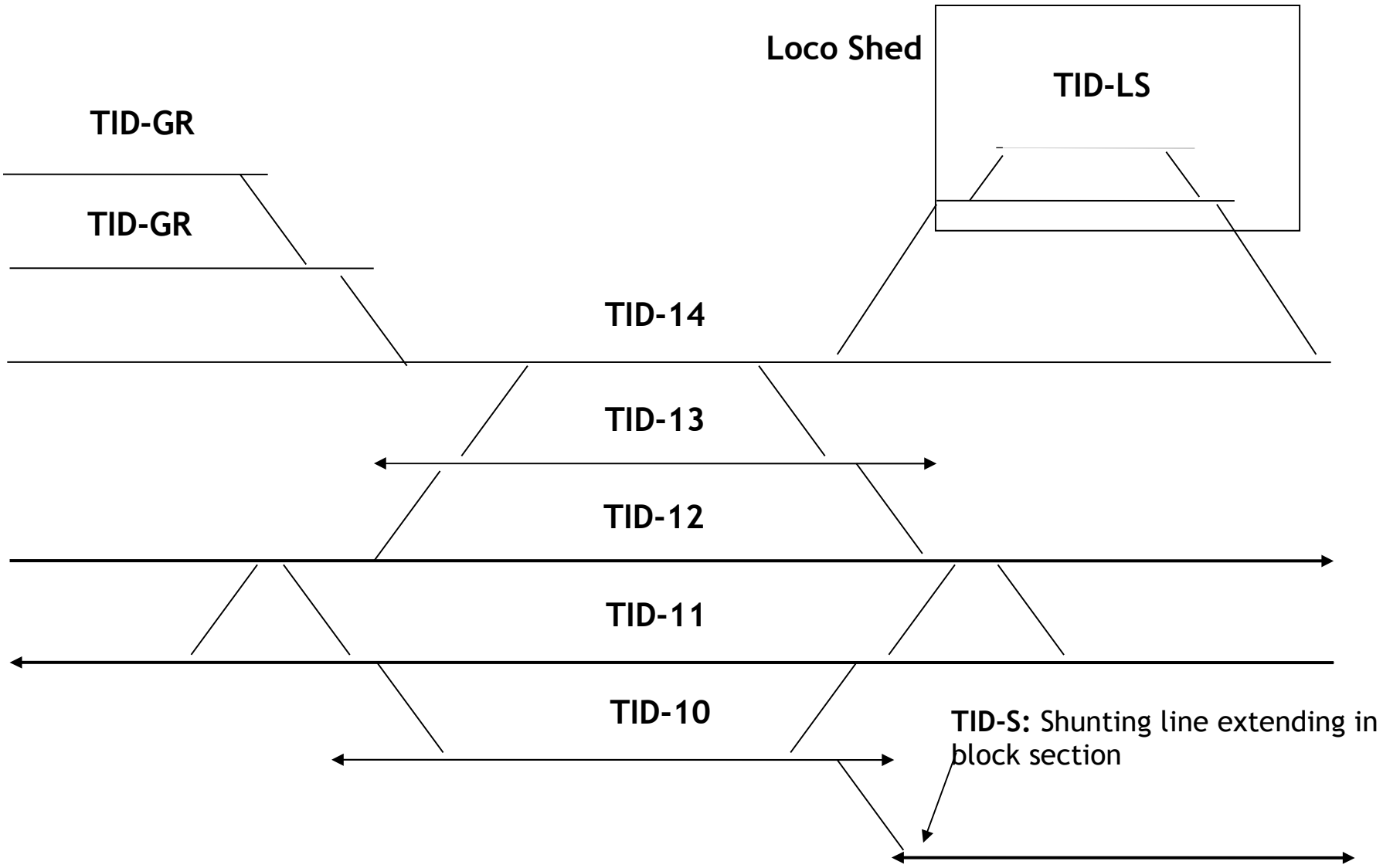


Database of TID Plans of Stations, GPS shadow zones, Level Crossings and Repeaters on ACD Routes are stored in memory of 'Loco' & 'Guard' ACDs

Track Identification Digit (Track-ID) & Types

- **TID** is a two digit decimal number that uniquely identifies the track on which a Loco or Guard ACD is located inside the ACD territory
- **Types**
  - **TID-NU :** Track-ID Neutral
  - **TID-FS :** Track-ID Fail-Safe
  - **TID-GR :** Track-ID Group
  - **TID-S :** Track-ID Siding
  - **TID-LS :** Track-ID Loco Shed
  - **TID-SR :** Track-ID Speed Restriction

Station TID Plan



Initialization of ACD fitted Train

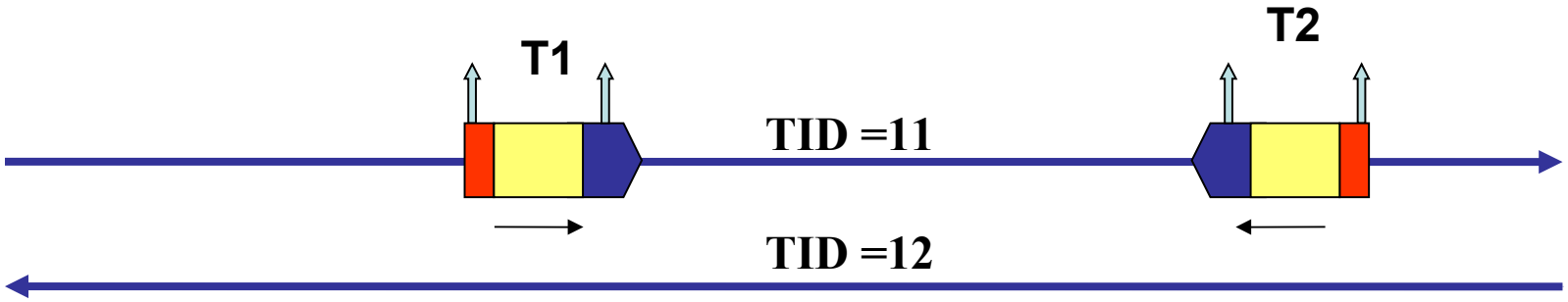
- At Train originating Station, Guard ACD is loaded and switched ‘on’
- As soon as Train starts, Loco ACD will identify ‘automatically’ its Guard ACD and radiate its ‘Guard ACD – ID’
- On receipt of data packet from a Loco ACD containing its ‘ACD-ID’, the Guard ACD will assume the ‘Loco ACD-ID’ and ‘Track-ID’ of that Loco ACD, thus forming a ‘CYBER’ Train

Initialization of ACD fitted Train

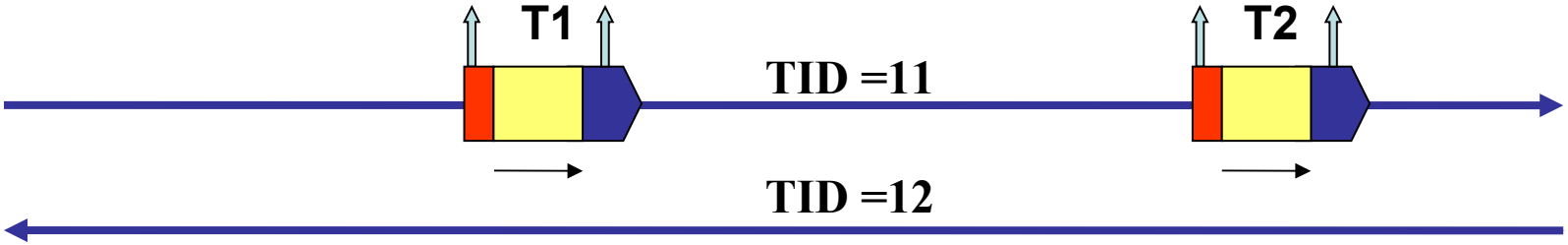
- Loco ACD will conduct an ‘Auto Brake Test’ (ABT), moment its speed becomes 50 Km/hr and reduce it by 20 Km/hr to deduce the ‘braking characteristics’ of its Train
- ACD fitted train would now apply brakes based on its braking characteristics, whenever a collision-like situation is perceived

Prevention of Collision in 'Mid-section' - 1

Prevention of 'Head- on' Collision

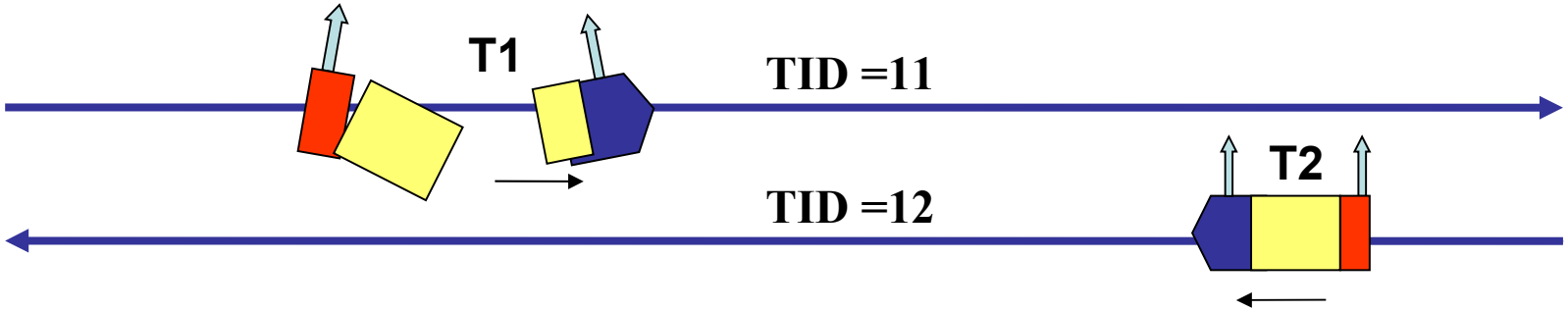


Prevention of 'Rear- end' Collision

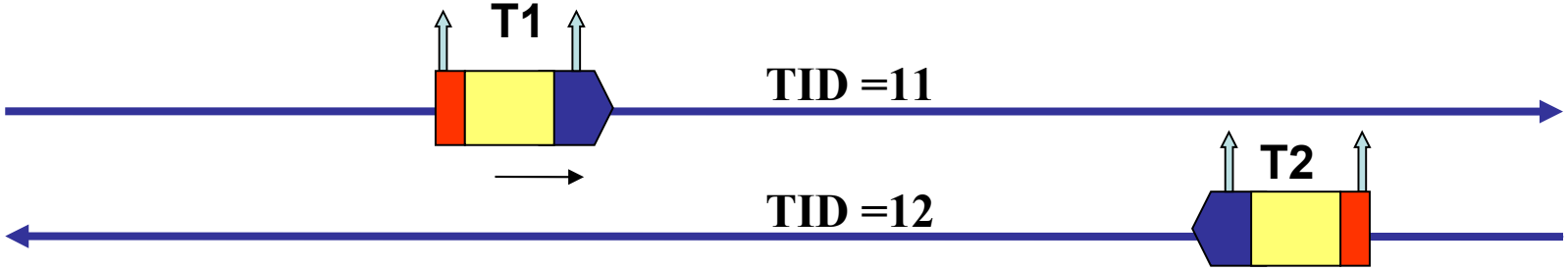


Prevention of 'Side' Collision

Train Parted, Derailed & Infringing Adjacent Track

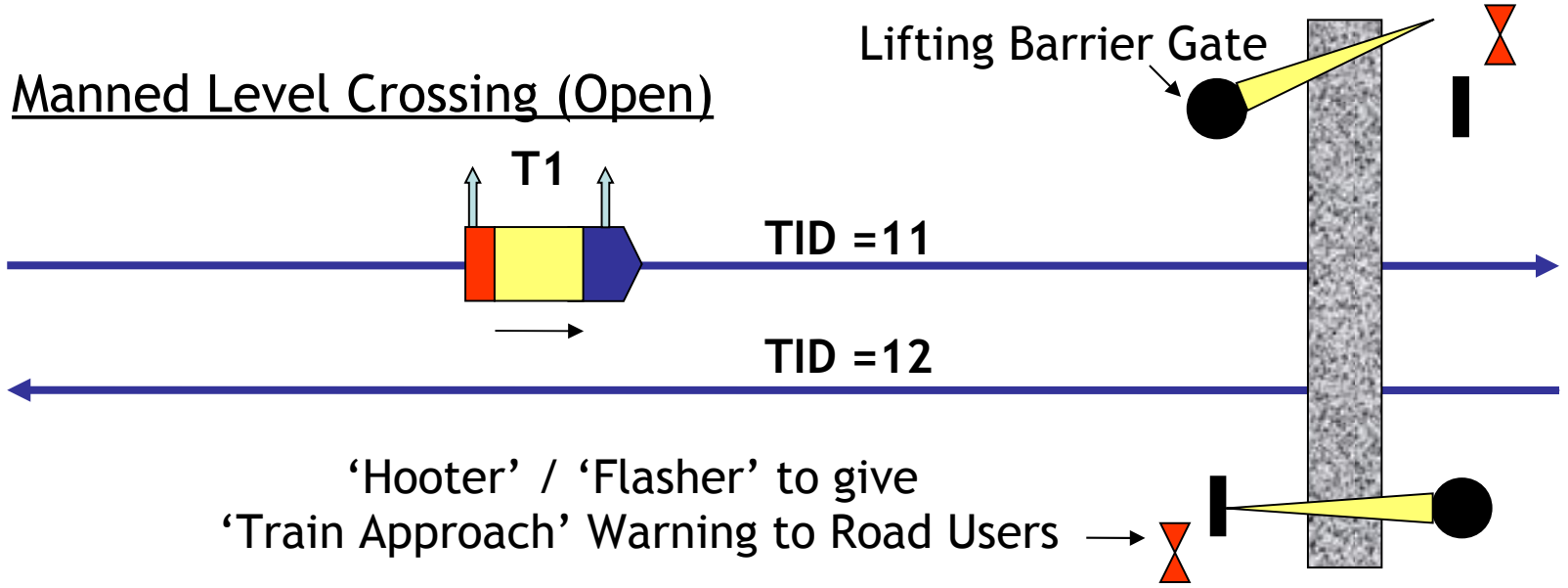


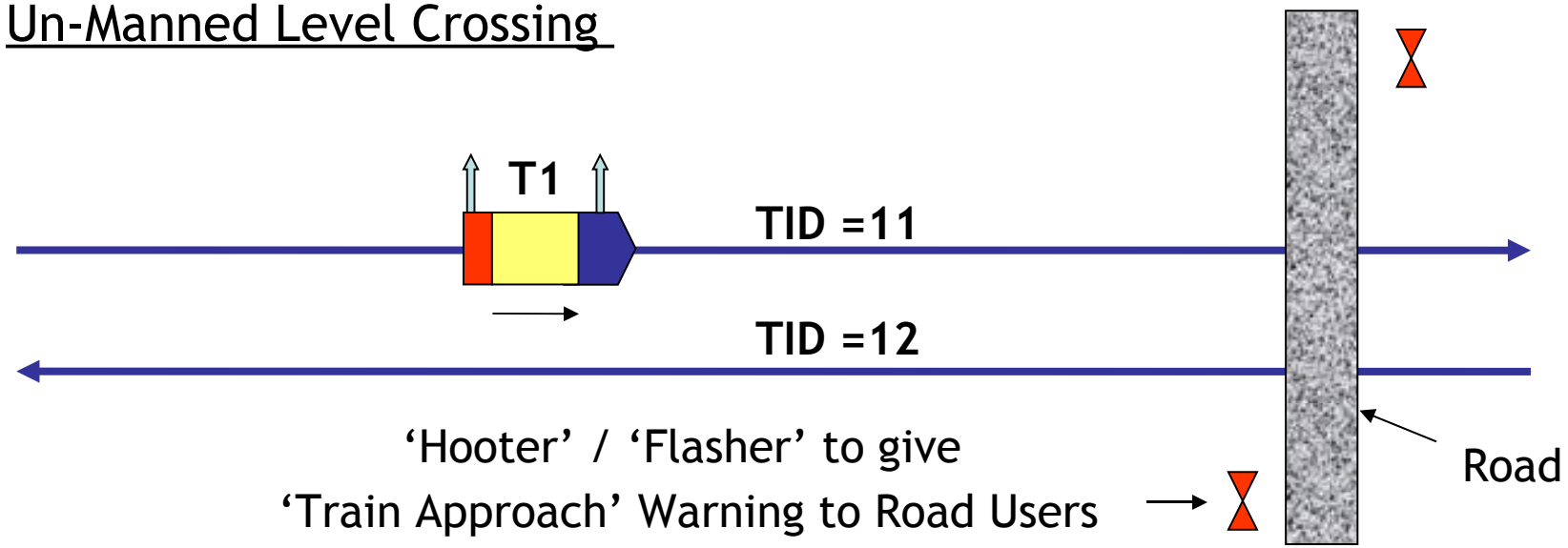
Prevention of 'Side' Collision



Stationary (might have derailed)

Prevention of Collision at Level Crossing





‘ACD Network’ - Implementation Plan

- ACD Survey & Route Design
- Manufacturing and Installation of ACDs with accessories
- Commissioning of individual ACD installations
- Training of Personnel
- Configuration & Customization of ACD route during ‘Incubation’ period
- Commissioning of ACD Route
- Post warranty Annual Maintenance (if required)

ACD Survey & Route Design : A Methodology…

- Preparation of ‘Track-ID’ Plans from Engg. & Signaling Plans
- Listing out of Level Crossings along the proposed ‘ACD Route’
- Mapping of Station Boundaries & locations of LCs
- Creating Data base of ‘TID plans’ & LCs
- TID (Deviation Count) Survey on Points & X-ing at Stations
- GPS & Inter-ACD Radio communication Survey for identifying GPS & Radio Communication shadow zones
- Creating database of ‘GPS shadow zones’ & finalizing the requirements of ‘ACD Repeaters’
- Detailed ACD Survey Report (including cost)

“I need the ACD, ACD does not need me”
- A Train Driver

Merci !

Obrigado!

谢谢 !

Tack !

شکرا!

Asante !

Grazie !

Takk !

Danke !

ありがとう!

مرسی یا تشکر یا متشکرم

¡Agradece!

감사합니다 !

Спасибо!

धन्यवाद !

Thanks !

תודה, תודה לך!