**Real time visualization of Trains, Signals, Tracks and Level crossings using FRMCS technology for Indian Railways**

**Loco Pilot Scenario**

Assumptions

Train station #1: Thrissur

Train station #2: OLLUR

Train : Kasaragod Trivandrum Parasuram express on platform # 1 going towards Ernakulam

Two manual level crossings

Signaling systems : Multi aspect signaling system using “Block Control” or “Multiple Axle counting” method.

Scene 1: Thrissur Station - Pre-Boarding

* Wide shot of Thrissur Railway Station, platform #1, with the Kasargod Trivandrum Parasuram express train parked
* Zoom in to the train engine, loco pilot's cabin
* Loco pilot approaches the engine
* Close-up of loco pilot's view of the Display Unit

Scene 2: Loco Pilot's Dashboard - Pre-Departure

* Display Unit on the dashboard flashes
* Display console shows RED signal on the Top Right side (along with a Label Signal View) corresponding to the real time signal status
* Loco pilot checks the Display Unit, confirming the RED signal
* Display transitions from RED to GREEN signal
* Loco pilot blows the horn
* Loco pilot releases the brakes and the train starts moving

Scene 3: Real-Time Display - Departure

* Close-up of the Display Unit showing GREEN signal for the upcoming block
* When the train enters the next "BLOCK" the corresponding signal turns Red in the pilot's console with a lag as per the Railway SoP.
* Block IDs before and after the train within the loco pilot's Geo fence should be clearly visible along with their real-time signal status as the train moves from block to block
* View of the track side LTE-R communication towers passing by is shown with labels

Scene 4: Level Crossing #1 Approach - Display Information

* Text overlay: "2 km to Level Crossing #1"
* Display Unit updates, showing the upcoming level crossing and the LC signal status corresponding to road view turns RED on the Loco Pilot console on the Top Left side (along with a Label LC View) to demonstrate to the loco pilot that it is safe to pass through at full speed.
* Loco pilot sees the Level Crossing #1 status turning YELLOW on the Display Unit as the train crosses the LC #1
* Signal status corresponding to LC #1 changes to GREEN as the train moves ahead as per the Railway SoP
* Block signals continue to be shown as train enters and leaves each block
* Track side LTE-R Mobile towers will also be shown continuously

Scene 5: Approaching Ollur Station

* View of the simulated platform tracks on the Loco Pilots control panel. A train parked on the platform #2 can be explicitly seen (with flashing icon) by the Loco Pilot along with flashing RED signal (Top Right) on the occupied track
* Real time signal status before and after the train within the train Geo fence are also continuously visible
* Station Master/ Station Control Room directs the train into platform #1 at Ollur station
* Train rolls into Ollur Station and stops at the end
* Block Signal in front of the loco pilot is RED, visible on the Display Unit

Scene 6: Cab Radio Communication - Display Update

* Loco pilot uses Cab radio to communicate with the station master with voice over
* Text overlay: "Communication via LTE-R / 5G / FRMCS"
* Display Unit shows the communication interfaces inside and outside the Train engine
* [Display updates with the communication status]

**Trivandrum North (Kochu veli) Station Control Panel Scenario**

Scene 1: Railway Station Control Room

Station Master enters the station control room..

He/She looks at the control panel and checks the status of home signals and other block signals

Station master can see the real time status of trains (explicitly flashing) as they enter or leave the station Geo fence. Station master can also see the real time position (track and location) of train/s parked in his/her station

Station master can see the real time status of signals in his/her jurisdiction on the Top Right side of the console.

Station master can see the real time status of Level Crossings in his/her jurisdiction on the Top Left side of the console.

Station master sets the home signal and other signals on the middle track to allow a passing train to enter the station zone from the up line and sees the train moving through the station. These signals and train icon will keep flashing when active within the station geo fence

The console shows the speed and length of the train and direction of movement. The home signal and other signals are automatically and sequentially get reset after the train passes through.

The station master uses the VoIP facility to communicate with the loco pilot of the passing Train # 22208 specifically to ensure the maintenance of speed limit. He/she can be shown communicating with the LC guard with a voice overlay.

Station master then sets the home signal and other signals for another train to enter from the down line and stop on platform number 1. The train can be visualised on the console entering the station and stopping on platform 1. The down side and up side signals on platform 1 will automatically change to RED on the console.

The station master can also view the ambient conditions within the station geo fence like temperature, humidity and track visibility on the bottom of the console.

**Trivandrum Divisional Traffic Control Room Scenario**

Assumptions:

There will be zonal/regional control centers for rail traffic management

These centers will have view access of rail traffic and related functions within their jurisdiction except in the case of temporary modification of train precedence . They cannot intervene in the operations real time but can enquire or instruct the station master over VoIP. They can also communicate, escalate to the up line management in case of a contingency and also provide status reports from time to time.

An important function of the Traffic Control Center is recording and maintaining all relevant historical data in their jurisdiction. This can include audio & video feeds, audit trails for data and individuals for fixing accountability and for cyber forensic requirements. The format and access control of this data needs to be as per Railway SoPs.

* Traffic controller enters the Control center. The video pans the control center and shows large wall to wall video consoles and operators manning those consoles.
* Video pans to one individual console in the control center. The console shows a subset of overall control system on a Railway Map (similar to Open Railway Map -<https://www.openrailwaymap.org/)> with trains moving in/out and located inside the jurisdiction of the control centre within that sub area.
* Trains icons are shown along with Train numbers. An Green icon shows trains maintaining speed within the allowed speed limit A flashing Yellow icon corresponds to a train exceeding the allowed speed limit in that rail bloc.
* Video also shows the real time status of all signal positions within the above subset with track side signals (this can be a subset of signals in on different routes picked and shown at random on a rotating basis) the Top Right and all Level Crossing (this can be a subset of LC signals in on different routes picked and shown at random on a rotating basis) signals on Top Left. Video also shows some signals changing and trains entering and leaving the railway blocks at real time
* Any identified signal failure will trigger an audio as well as video alarm on the control panel. One such situation can be simulated on a control console.
* Video console also shows station icons in the above subset with traffic in and out of the stations in real time.
* Suddenly the icon corresponding to Train no 22208 is seen flashing Yellow icon indicating that the train is speeding above the allowed maximum speed limit in a section
* Traffic controller uses VoIP phone to communicate with the concerned station master within his/her jurisdiction to communicate/confirm the status of Train # 22208.
* The traffic controller can modify the train schedules to ensure that a lower priority train is shifted to the loop line and held on a different track to allow a higher priority train to pass through. Once decided this is communicated on VoIP to the concerned Station Master to implement. This communication will be followed by an Email in a standard format stating the changes to be made for audit purpose.
* Video also shows external communication devices above the traffic control center building like satellite receivers and redundant communication towers for LTE-R.