



GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS

Pamphlet on SMART COACH



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अभारुत रूडरुड
रेल अग्रवूत Transforming Railways



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Introduction

Smart Coach aims to provide world-class facilities to passengers with the help of an intelligent sensor-based system. With the use of SMART Caoch, Indian Railways aims to move to predictive maintenance instead of preventive maintenance. To make passengers more comfortable in the journey, the Railways has built a Smart Coach, which will provide many types of facilities. pilot in both cabs. Similar arrangement of controls in both cabs for easier operation of locomotives. Additional controls given to Assistant loco pilot such as Horns, Emergency brake valve for better control of locomotive.

Features of Smart Coaches :

- ◆ Digital Destination Board
- ◆ Switch Cabinet Board
- ◆ GPS based Public Announcement System
- ◆ Monitoring of RMPU (AC packaged unit) analytics regarding health status of respective compressor and low cooling and low heating using PICCU.
- ◆ CCTV surveillance with 6 cameras
- ◆ Display of Water Level Indicator
- ◆ On board Condition Monitoring system comprising of :
 - i) Wireless Wheel Node sensor for recording real time condition of Wheel, Axles & Bearings.
 - ii)Vibration analysis of wheel, axles & bearings to generate warning signs of an impending crack or track defect.

- ◆ Emergency Call Box enabling emergency call back.
- ◆ Wi-Fi System with pre-loaded media content.

Passenger Information and Coach Computing Unit (PICCU)

Smart Coach has a passenger Information and Coach Computing unit (PICCU) a CPU that is similar to an industrial grade computer. This has been provided with GSM network which sends execution reports to the remote server. PICCU will monitor 4 important areas of coach maintenance and passenger interface.

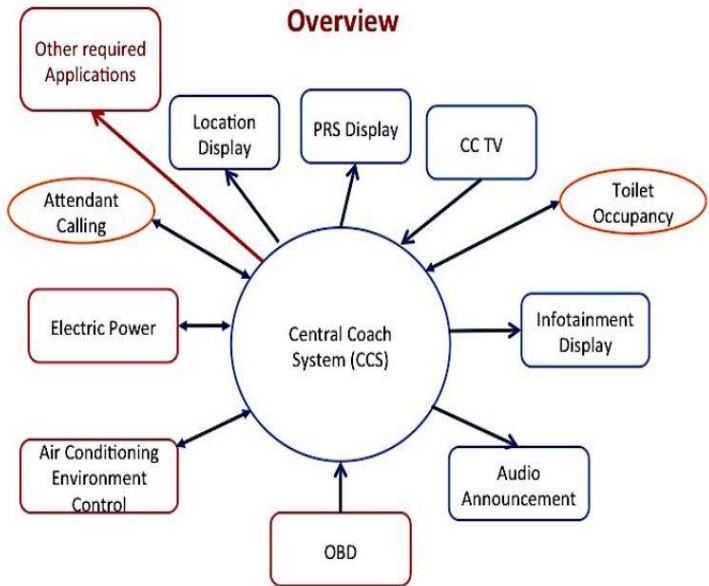
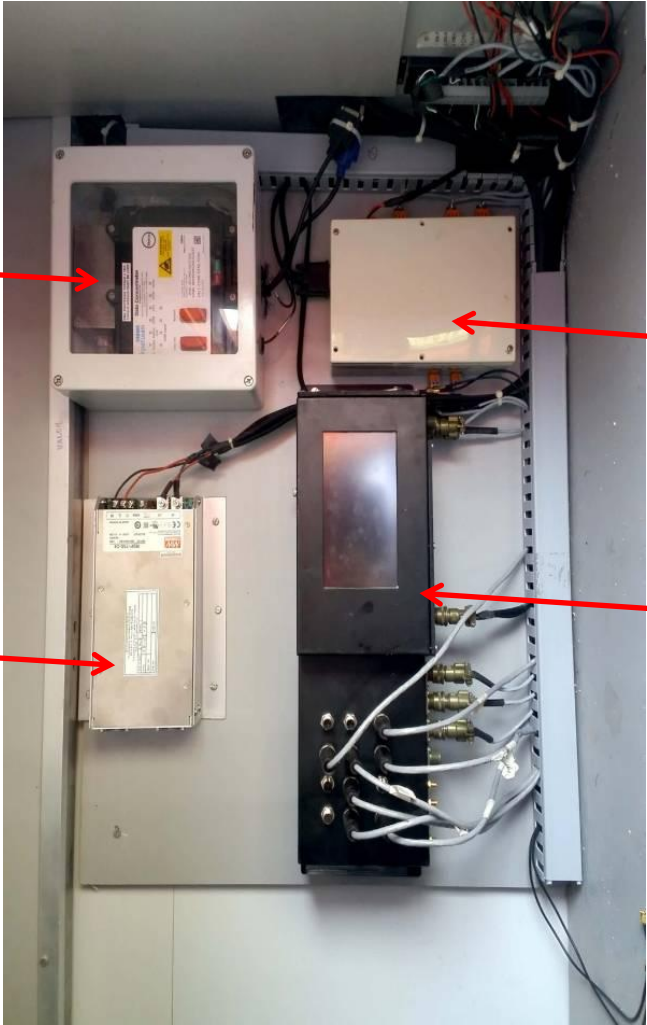


Fig.1: Schematic of PICCU

Data concentrator

Power Supply Module



Collibri Box

Main processing unit

Fig.2:

Amenities provided in Smart Coach

1. Passenger interface

(a) Digital destination board

First time in Indian Railways a Flush type LED Digital Destination Board has been installed on a coach. This has been done by compacting the Display board by splitting the displayed data into two rows :

- i) Row 1 : train number and Coach type
- ii) Row 2 : Scrolling text display of destination and intermediate station in multiple languages.

Optimizing character height to 80 mm for rationally arrived at 25 meter visibility.



Fig.3: Outer view of Smart Coach

(b) PAPIS (Passenger announcement/ passenger information system)

Two number of LCDs on the coach show vital journey related information to the passengers as to the next station, distance remaining, expected time of arrival, delay and safety messages.

A PIS application on the PICCU manages the display content. Automated GPS based announcement triggers from PICCU manages the display content. Automated GPS based announcement triggers from PICCU using pre-recorded voice segments ensure an informed journey for the passengers.



Fig.4: Passenger announcement/ passenger information system (PAPIS)

(c) WI-FI infotainment system

Passengers can download an app on their handled devices and laptops to browse and view content pre stored on the PICCU. The coach is covered with an industrial grade access point ensuring a steady coverage for the entire coach. Passengers can view Movies, Songs, videos, Play games and also view journey progression on their handhelds.

In forthcoming version, of Optiplay, passengers can summon help on the train and also give feedback about services on the train and/or report cleanliness issues.



Fig.5: Outer view of Smart Coach

(d) Emergency Talkback

In case of a medical or security emergency, a passenger will be able to generate a call register for the train supervisor. This feature will improve response time of staff and also reduce chain pulling significantly.



Fig.6: Emergency Talkback equipment

2. Security & Surveillance monitoring

- Video analytics [this shall be demonstrated in Version 2.0 due soon]
- Video surveillance



Fig.7: PICCU display unit

6 cameras fitted on the coach give live recording. In case of an emergency, the control centre can view the proceedings on the coach. Traditional CCTV systems require security personnel to visit the coach to extract incriminating footage. With PICCU, authorised personnel can extract the footage from the control centre directly. For train set configurations, PICCU's of a train can be networked for a single point monitoring from within entire train.

3. On Board condition monitoring system

The Energy harvester based sensor monitors the condition of wheel, bearing and hard spots on the Track. The same is fed to the data concentrator and transmitted via GPS/GPRS to a remote server. The data can be used for diagnosis. Wheel defects, bearing defects are both reported up to 6 months prior to their becoming critical, giving sufficient time to schedule maintenance time.



Fig.8: Energy harvester based sensor

The System is capable of picking up very early warning signs of an impending crack or track defect based on vibration analysis. However, the system has to be fitted on sufficient trains for generating the required resolution of data to generate these alerts

4. Interface with all the subsystems and their monitoring

(a) HVAC [Heating ventilation and air conditioning unit]

Currently the parameters being monitored are compressor pressure, air temperature and pressure of supply and return air, humidity sensor, temperature sensor module blocked status , blower motor, condenser motor, heater blockage etc. Analytics regarding health status of respective compressor and low cooling and low heating are being monitored.

Item being proposed in Version 2.0 are Clogged filter indicator, Air quality index (measurement & apps development), Ozone Level, Particulate pollution PM 10, PM 2.5, CO, SO₂, NO₂ monitoring, HEPA filter, Electrostatic filter, UV filter.



Fig.9: Heating Ventilation & Air Conditioning Unit

(b) WLI [Water Level Indicator]

A SMS shall be sent to the next watering station when the water level falls below half. This can be programmed at the base monitoring unit [Coaching Depot]



Fig.10:
Water level indicator (Display) (Inside of coach)



Fig. 11:
Water level indicator (Display) (Outside of coach)

(c) WSP [Wheel Slip Protection monitoring]

The data from the WSP is available at the PICCU and parameters can be monitored remotely. Integration of WSPD with PICCU and posting of data live on the web server will help Railways detect faulty valves, brake binding cases wheel slips better, and prevent premature turning of wheels. This may obviate the need for wheel profile measurement systems in future as analytics improve.

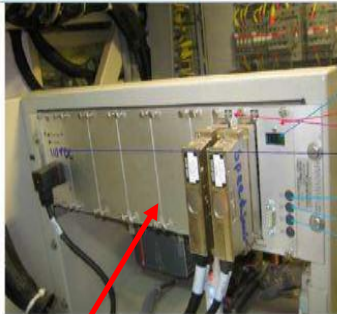
Speed sensor



Phonic wheel



Dump valve



Display

MB 04 Card

EB 01 Card

PB 03 Card

S1 Display Button

S2 Test Button

S3 Clear Button

**Central Control & processing
Unit (ESRA- Electronics
standard for Railway
application)**

Fig. 12: Components of WSP



Fig. 13: Speed sensor installed on phonic wheel

The Data from the PICCU and OBCMS are being fed to remote servers. Currently they are being hosted in the respective suppliers servers. Data support for six years should be available.

Check list for the fitment of Smart Coach

S. No.	Description	Qty.	Fitment Status	Functional Status
Hardware Items				
1.	Passenger Information and Coach Computing unit Apps below manageable remotely with open source Linux platform, with inbuilt 7" Touch screen, DC-DC converter and PA amplifier (PICCU).	1		
2	Chocked filter sensor.	1		
3	Air quality measurement unit comprising CO ₂ , PM 2.5, VOC and PM 10 sensors.	1		
4	Energy metering Module.	1		
5	Water level sensing module.	1		
6	Wireless access point with inbuilt Antenna and 802.11 b/g/n/ac compliance.	1		
7	IP based LCD display panel for passenger information system	2		
8	Digital destination board with flush mounted coach body frame with 2 line of 16x96 display 5 mm pitch and RS485 interface	2		

S. No.	Description	Qty.	Fitment Status	Functional Status
Hardware Items				
9.	100W X 2 DC-DC converter for 110 V to 24 V DC conversions	1		
10	GSM-GPS combo Antenna with anti-theft protection	1		
11	6 W speakers with SS mounting Bracket	10		
12	POE cameras for CCTV application	6		
13	Emergency Duplex Talk Back with Guard on Train network	1		
14	Train Ethernet coupler for train wide high speed Ethernet networking	2		
15	12 prt EN50155 Certified Managed switch with train Ethernet networking	1		
16	Wireless sensor Node (WSN0 for vibration monitoring of bearing, wheel and track health	8		
17	Brackets for WSN	8		
18	WSN wireless management module for integration in to PICCU	1		
19	RF antenna for under frame for capturing data from WSN	1		

S. No.	Description	Qty.	Fitment Status	Functional Status
Hardware Items				
20	Toilet Occupancy Sensor	4		
21	Toilet Odour Sensor	4		
22	Ventilation Fan Sensor	2		
23	Decal	2		
24	Chocked Lavatory Detection system Sensor	4		
25	Water Curtain Sensor	4		
26	Water Trap Sensor	4		
Software and its Application				
27	Linux OS (Open Source)	1		
28	Software module (APP) for passenger Announcement /information system (PAPIS) RDSO/SPEC/AC/0087 Rev 1) with auto generated local PA announcement for running/commercial/safety etc. form Coach computer and connectivity to Central PA.	1		
29	Software for PA over IP module (needs train networking)	1		
30	CCTV application for Coaches	1		

S. No.	Description	Qty.	Fitment Status	Functional Status
Software and its Application				
31	CCTV Analytics module including face recognition and extraction	1		
32	Application software for infotainment system Wifi based as stored in Coach computer WiFi access for information on Smart devices (Without internet) wiFi access for PA-PIS on Smart devices (without internet)	1		
33	Application for interfacing of AC condition monitoring system (not including AC microprocessor controllers for RMPU's having Humidity & temperature control and online monitoring software)	1		
34	Application for data presentation on PICCU using manufactures API	1		
35	Application for automatic SMS generation for water level at next arriving station	1		

S. No.	Description	Qty.	Fitment Status	Functional Status
Software and its Application				
36	Application for data aggression of WSN with indication of bearing and wheel health on PICCU	1		
37	Cloud based centralized monitoring and management software per coach for remote management of the coach, fault reporting and diagnostics, data interchange for CCTV surveillance infotainment, PA-PIS(72 months)	1		
38	Wheel bearing and track monitoring application software (72 months)	--		
39	Centralized Application software, cost per coach (one time configuration change)	1		
40	GSM Data communication Cost (72 months)			
41	Wire Cables and connectors	As per requirements		
42	Installation & Commissioning			

**Integration to be done as per specification
MMDTS 18042 Rev. Nil**

S. No	Description	Integration with PICCU
1	Monitoring of working of water pump	
2	RMPU AC Unit compact controller	
3	Wheel Slip protection Device of Various makes	
4	Fire and Smoke Detection Unit with integration to PICCU PA/PIS system for emergency Evacuation	
5	Switch Board Cabinet	

DISCLAIMER

The information contained in this pamphlet does not supersede any existing provisions laid down in RDSO & Railway Board instructions. This document is not statutory & instructions given in it are for the purpose of guidance only