SPECIFICATION
FOR
DATA LOGGER SYSTEM
FOR
RAILWAY S&T INSTALLATIONS

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Abstract This document defines Data Logger System for Railway S & T installation.			

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NAME	ORGANIZATION	FUNCTION	LEVEL
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AMENDMENTS

Version	Chapter/ Annexure	Amendment	Effective date
IRS: S: 99/ 2001		FIRST ISSUE	August 2001
IRS: S: 99/ 2001		Amendment 1	12th February 2002
IRS: S: 99/ 2001		Amendment 2	30th September 2004
IRS: S: 99/ 2006		Amendment 3	5th April 2006
IRS: S: 99/ 2024		Amendment 4	

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Amendment 3 (Details)

Sl.	Clause	Amendment	status	Remarks
1.	1.2	2	Add	To clarify The scope of inspection of Modem & CMU
2.	3.3	3	Modified	Output relay capable to drive 24V Q-Series Relay
3.	3.4	3	Modified	Field gear shall not load >1%
4.	3.7	3	Modified	Forced Cooling to be deleted
5.	3.8	3	Modified	To Print in user friendly mode
6.	3.9	3	Modified	Format to include location name& Channel no.
7.	3.10.1 (vii) & (xvii)	3	Deleted & subsequent clause renumbered	To delete Three position inputs
8.	3.10.2 (iv)	3	Deleted & subsequent clause renumbered	Covered by Digital Input
9.	3.13	3	Add	To include Version control
10.	4.1(vi)	2 & 3	Add	To add modem
11.	4.2.2	3	Modified	RTU Event Capacity Defined
12.	4.2.7.1	1&3	Deleted	To delete synchronization of control office digital clock
13.	4.2.10	3	Modified	Storing capacity to increase upto 10 lac
14.	4.2.12	1&3	Add & Modified	To clarify input variation storing percentage of analog
15.	4.2.17	3	Modified	Power Supply as per spn 144
16.	4.2.18	3	Modified	To make modular & Ergonomic design
17.	4.2.19	2 & 3	Add	To include transmission media
18.	4.2.20	2	Add	Common protocol between RTU & DL
19.	4.2.21	3	Add	Capacity of one cabinet 1024 Digital & 64 Analog

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20.	4.2.22	3	Add	Termination of All input Like Wago etc
21.	4.3.1	2 & 3	Modified	Specification of PC for CMU upgraded to state of art & Sub clause added
22.	4.3.8	3	Modified	FEP must have capacity to store 10 lac telegrams
23.	4.3.9	1 & 3	Modified	Details of common protocol
24.	5.5	3	Modified	Transmission rate to increase up to 57600 BPS
25.	5.6.1	3	Modified	Sub clause Number given
26.	5.6.2	3	Modified	Sub clause Number given
27.	6.3.1	3	Add	Applied high voltage test added
28.	7.1	3	Add	Sub clause number given
29.	7.2	3	Modified	IR test as per RDSO/SPN/144/2006 & Sub clause added
30.	7.3	3	Modified	Environmental as per RDSO/SPN/144/2006 & Sub clause added
31.	7.4	3	Add	Applied high voltage test as per RDSO/SPN/144/2006 & Sub clause added
32.	10.4	3	Add	Pre-commissioning check list & Dos and DON'Ts
33.	11.1.1	3	Modified	Sub clause given number
34.	11.2	3	Modified	"Additional" ward added
35.	11.4 ©	2	Delete	Deleted against Cl:4.1.(a) (vi)
36.	11.5 & 11.5.1	3	Delete	Deleted against Cl:4.2.17
37.	Annexure	3	Add	Added as per clause 4.3.9

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GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS
(RAILWAY BOARD)

INDIAN RAILWAYS
STANDARD SPECIFICATIONS

FOR

DATA LOGGER SYSTEM

(TENTATIVE)

Serial No. S 99/ 2024

0 FOREWORD

0.1 This specification is issued under the fixed serial number followed by the year of adoption as standard or in case of revision, year of latest revision.

0.2 This specification requires reference to the following specifications: -

IRS: S23	Electrical signalling and interlocking equipment
RDSO/SPN/144	Safety and reliability requirement of electronic signalling equipment
IS: 9000	Basic environmental testing procedures for electronic and electrical items

Wherever, reference to any specification appears in this document, it shall be taken as a reference to the latest version of that specification unless the year of issue of the specification is specifically stated.

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1 SCOPE

This specification covers the technical and operational requirements of data logger equipment, which is installed to monitor the status of the signalling gear at stations. It covers minimum configuration of central monitoring unit (CMU) and network interface devices at station, arrangements at central location for safe and secure data dissemination to sub systems & the users.

1.1 Inspection shall be carried out for data logger equipment consisting of FEP, Data logger, network interface devices, CMU software. Standard accessories used external to the data logger like PC for CMU, UPS for CMU and modem etc. shall be checked during inspection for their functional performance required for data logger system as per specification.

2 TERMINOLOGY

2.1 For the purpose of this specification, the terminology given in IRS: S23 and RDSO/ SPN/144 shall apply.

2.2 Input module means an electronic module/ card used to read status of relays (digital input) and/or level of analog signals**.**

2.3 Signal Conditioner means an electronic module or card used to convert analog signals to a suitable level for recording.

2.4 Electronic interlocking is a processor based electronic system to control signaling equipment/ functions at any interlocked station.

2.5 Integrated power supply (IPS) is a composite module delivering various AC and DC voltage for signaling equipment.

3 GENERAL REQUIREMENTS

3.1 The system shall chronologically monitor and record the status of various field functions like track circuits, points, signals, operator's push buttons/switches (digital Inputs) and level of various analog signals like DC and AC supply voltages etc. It shall also capable to receive diagnostic data from processor-based equipment like EI, MSDAC, IPS etc.

3.2 The equipment shall also have the capability of statistical analysis, predict the faults and generate failure reports. It shall be possible for the user to define fault logics taking digital/analog inputs into consideration and generate reports for such faults.

3.3 The equipment shall be capable of generating audio-visual alarm under defined conditions. In addition, it shall be able to deliver non-vital relay outputs on receipt of command from CMU. At least 8 non-vital relay outputs shall be provided. The non-vital relay output shall be in the form of potential free contacts capable of driving 24V 'Q' series relays These outputs may be used for non-vital functions like radio patching of control circuits etc.

3.4 For digital inputs, potential free contacts shall be used. Analog signals shall be scaled to a suitable limit using signal conditioner before converting to digital signal. While tapping analog input, it shall not load the analog channel/ field gear by more than 1% of rated load.

3.5 The system shall be suitable for working on non-electrified, AC electrified and DC electrified areas and where passenger/freight trains hauled by single phase thyristor controlled or three phase induction motor-controlled AC locomotives or chopper controlled EMU stock are operated.

3.6 The system shall be capable of working in conjunction with conventional relay interlocking, multi-aspect color light signaling installations operated by lever frames/ slides & Electronic Interlocking systems. It shall have facility to log data received from Electronic Interlocking through a serial port.

3.7 The system (except industrial PC used for CMU) shall be capable of working inan ambient temperature range of -10^0 C to $+70^0$ C and relative humidity up to 95% at ambient temperature of 40^0 C. Special protection against ingress of dust, moisture etc. shall be provided.

3.8 The data logger shall be capable of being connected to a printer for obtaining a hard copy of the function recorded. It shall be possible to print the following on the connected printer by selecting from user friendly menu

(i) on line events as they are generated.
(ii) to print the exception report
(iii)to print the status of user specified inputs for user definable time period

3.9 The data logger shall record various field functions as indicated in para 3.10 below chronologically in the following format with name of the location at top of every page:

Date, time, channel no., field function, status / value

3.10 Relays and potential free contacts to be wired as digital inputs and analogue inputs to be monitored are listed in the ANNEXURE- B1.

3.11 The system shall be easily re-configurable to any changes required by user**,** whenever modifications are carried out in the yard.

3.12 Provision for networking and remote monitoring of several data loggers from the central place shall be provided.

3.13 Implementation of version control and change of software shall be as per RDSO/SPN/144

3.14 Data validation, analysis and storage sub-systems at central location shall have redundancy to ensure ~~data safety~~ data security.

3.15 Proper system for data security shall be adopted to ensure unauthorized access to the data stored at central location.

3.16 Data analysis results i.e. fault alarms, reports etc. are to be conveyed to the user on mobile, tablet through SMS or App based message with least delay.

4 TECHNICAL REQUIREMENTS

4.1 Data logger system consists of:

(a) Data logger equipment which is provided near the signaling gears at station, cabins / gumties, interlocked LC gates, IBSs, Auto signal locations etc. to be monitored has following modules:

(i) Processor module.
(ii) Input module (digital/ analog)
(iii) Signal conditioning module
(iv) Communication module i.e. E1 converters, Ethernet converter & Media Converters module and Leased line Voice Modem(s)
(i) Printer 80 Col. Dot matrix (Optional)

(b) Central monitoring unit [CMU] with communication facility to retrieve data from data logger(s) provided at station(s). The central monitoring unit shall run the diagnostic software to generate alarm and exception reports and post them in a server for access by local and remote users.

(c) The validated events of data loggers and alarms generated by CMU are to be stored in parallel servers to ensure ~~data security~~ data security.

(d) Provision shall be made for dissemination of fault notifications, reports etc. on user's mobile,tablet.

4.2 **Data Logger Equipment*:***

4.2.1 The equipment shall cater for minimum 128 digital inputs (in the form of potential free contacts) and 16 analog inputs. The system shall be expandable up

to 4096 digital & 96 analog inputs by expansion/cascading the similar equipment.

4.2.2 Signal conditioning module shall convert analog signals like 230 VAC, 110 VAC, 110 VDC, 60 VDC, 24 VDC, 12VDC and etc. to suitable level for recording. Normally all AC voltages shall be at commercial frequency of 50 HZ. When an analog channel is not connected, it shall not pick up any noise.

4.2.3 Configuration of analog channels may be as under;

Channel	Nominal Voltage DC or AC (RMS)	Voltage Range for no alarm (adjustable)
1	230 AC	207- 253
2	110 AC	99- 121
3	110 AC	99- 121
4	110 DC	99- 121
5	60 DC	55- 69
6	60 DC	55- 69
7	24 DC	22.5-28
8	24 DC	22.5-28

Or as specified by purchaser.

4.2.4 Display shall be provided on the front panel of the data logger to display current status of events along with time stamp. At least two row display shall be used with at least 16 characters in each row.

4.2.5 The equipment shall have real time clock for recording time at which the status of an input has changed. The real time clock on data logger should get synchronized with the central monitoring unit. It shall be possible to obtain external clock signal from systems like IRNSS and suitable arrangement shall be made for this.

4.2.6 Opto-couplers may be provided to electrically isolate each external digital inputs (relay contacts) from the equipment. Self-diagnostics shall be provided in the system. Any fault in the system shall generate error message in the system paneland generate alarm in the CMU.

4.2.7 The hardware structure of the system shall be modular.

4.2.8 Event logging facility for minimum 20 Lac events shall be provided in a Data logger. Data shall be recorded on first in – first out basis so that latest data is available in the system. There should be no loss of data from the data logger memory in case of power supply failure of data logger.

4.2.9 Scanning interval for digital inputs shall be less than 20 milliseconds. Change in status of digital signal shall only be recorded.

4.2.10 Scanning interval for analog signals like DC or AC supply voltage, temperature, etc. shall be less than 1 second. Variation of more than 5% of the nominal value from the last recorded value, provided it has gone 5% beyond the nominal value, shall be recorded.

4.2.11 Accuracy of measurement of analog signals shall be better than 1% within ~~±40%~~ ±30% of nominal value.

4.2.12 The equipment shall have facility to receive serial data from external equipment like Electronic Interlocking, MSDAC, SSDAC, SSBPAC, Integrated Power Supply etc. and record it withtime stamp. **ANNEXURE-B4**

4.2.13 The software of the system shall be of approved type and written in a structured format so that the purchaser can reconfigure it, if required. The software shall have clear bifurcation between generic software and application software.

4.2.14 At least 12 serial ports shall be provided for communication with other data loggers in gumity and adjacent stations, CMU, EI, IPS etc.

4.2.15 Power Supply: The system shall work on 24V DC (+20%,~~-30%~~ -20%). Railways willprovide 24VDC input supply.
The 24 VDC supply of Datalogger should be drawn from the DC-DC converter of the Integrated Power Supply (IPS). If IPS is not available in station or due to specific reason, the 230V charger with VRLA battery for the Datalogger may be installed in the IPS room with appropriate Class B and Class C protection. Battery charger and battery shall be procured from RDSO approved sources only.

4.2.16 Cabinet shall be modular and ergonomic in design with good maintainability. The cabinet should be powder coated. The front and backsides of the cabinets shall have the facility for locking the equipment.

4.2.17 Data Logger shall be capable of working with different transmission media like underground telecom cable, OFC (dark fiber or digital network~~)~~ & wireless network. It should be capable of working on E1 Channel, ethernet, GSM network along with existing 64kbps voice channel. The data logger equipment will continuously check the modem status and give the necessary reset as

required to eliminate modem hanging condition. The modem/converter will be housed within the data logger cabinet.

Indicative network diagram is shown in the **ANNEXURE-~~B6~~B2**

4.2.18 ~~Communication between data logger shall also be as per communication protocol mentioned in clause 4.3.9.~~

4.2.19 Cards and terminals required for up to minimum 1024 digital inputs 32 analog inputs, signal conditioning modules etc. shall be accommodated in one rack of 19" width.

4.2.20 For termination of external digital and analog inputs, international quality terminals of WAGO/ Phoenix etc. makes shall be used as per RDSO SPN/144. All wires should be neatly bunched in horizontal and vertical channels.

Preferably Push-In Type of terminals shall be used for termination of external digital and analog inputs.

4.2.21 Where dark fiber is used as communication media, to network data loggers in the block section or gumties / cabins to station data logger, suitable media converter shall be used. The technical parameters of media converter are given in annexure-B8/A.

4.2.22 Where copper cable is used as communication media to network data loggers in the block section or gumties / cabins to station data logger, suitable leased line voice modem shall be used. The technical parameters of the modem are given in Annexure-B8/B.

4.2.23 Where E1 data channel of OFC system is used as communication media, to network data loggers in the block section or gumties / cabins to station data logger, suitable data converters shall be used. The technical parameters of E1 data converter are given in Annexure-B8/C.

4.2.24 GSM based data communication shall also be used in case no wire communication system is available.

4.3 CENTRAL MONITORING UNIT (CMU):

4.3.1 Any good database management system i.e. SQL server, Interbase, Oracle server,IBMDB2, Maria DB etc. shall be used to cater for basic

function of Data loggers at CMU level. Only licensed software shall be used.

4.3.2 The specification for hardware is given in the ANNEXURE- B7

4.3.3 Central monitoring unit shall have Graphical User Interface (GUI) based software and retrieve data from all Networked data loggers (up to 32) at various stations. It shall store data in standard data base files. The CMU shall also be capable of analyzing the data & generate reports & audio-visual alarms on defined conditions. It shall be possible to compress the data and take backup.

4.3.4 Software used for analysis of data, prediction of faults etc. in central monitoring unit shall be of approved type and written in a structured format so that purchaser can reconfigure it, if required. A copy of software shall be supplied inCD.

4.3.5 It shall be possible to display the status of signaling gears at any selected time in graphic form for any selected station yard on the central monitoring unit.

4.3.6 It shall be possible to retrieve the stored data & simulate train movement on the central monitoring equipment.

4.3.7 It shall be possible to send commands to various Data loggers to activate audio, visual alarm or operate an electromagnetic relay.

4.3.8 It shall be possible to share data available in CMU/central servers by other PCs through available local area network where this data can be used for train charting / passenger information purpose / data analytics.

4.3.9 Front End Processor (FEP) shall be provided to continuously retrieve data from station data loggers. FEP must have capacity to store 10 lac telegrams. It should have 6 ports.

The communication protocol for transmitting data and command between data logger and CMU is given in Annexure-A.

4.3.10 Each CMU shall receive data from two redundant ethernet ports/Serial ports from data logger network.

4.3.11 CMUs at central location shall be duplicated to ensure data availability. Typical diagram is shown in the ANNEXURE-B2.

4.4 DATA STORAGE SYSTEM AT CENTRAL LOCATION:

4.4.1 Duplicated CMUs at central location shall post the data in two parallel servers. The schematic diagram is given in the annexure B2.

4.5 DATA DISSEMINATION SYSTEM:

4.5.1 Data consists of events generated by data logger system which are validated by CMU and stored in servers and alarms generated by the CMU and stored in servers.

4.5.1 Alarms generated are to be notified to the required persons on their mobile phones with least delay. An interactive App which enables collaborative working of all the personnel involved in fault rectification shall be provided for better availability of signaling system.

4.5.2 It shall be possible to view the online data and historic data stored in the servers by mobile phones, tablets and web-based system.

4.6 ETHERNET MODULE:

4.6.1 This module will provide data in ethernet for MPLS network.

4.6.1 Ethernet modules shall comply technical details given in Annexure-B5.

4.7 Mobile Application based messaging System:

4.7.1 The mobile apps based messaging software shall be Multi device support like Desktop/ Tablet/ Mobile.

4.7.2 Data access for application shall be through Data logger Interface software and Application Programming Interface (API). The Data logger interface software should have basic authentication of user before sharing any information through API. It shall provide information to multiple external user simultaneously.

4.7.3 The mobile apps based messaging software shall be compatible for both Android and iOS mobiles.

4.7.4 It shall require one time device authentication (android or iOS) as per pre-configuration in software there after option of auto-login will be given and same to agreed by user if desired. The authentication shall be based on Mobile no of Railway personnel. Authorised mobile number has to be fed in database and access from only theses number shall be allowed by sharing OTP.

4.7.5 The app should not permit log in of multiple devices with a single account (mobile no).

4.7.6 App should have provision to view various alarms/notifications.

4.7.7 Users can provide feedback on alarms/ notifications.

4.7.8 The architecture of both SMS based alarms and APP based alarms / notification system is given in Annexure-B9.

4.8 Cyber Security Requirement:

Following points shall be complied to ensure Cyber Security of Data logger system:

i. Any unauthorized software should strictly be prohibited in Data logger PC. Only those software should be allowed which are essential for operation of CMU. A list of software (with version number) installed in the PCs should be maintained at stations/Divisional HQs.

ii. Internet connection and installation of remote access software like "Any Desk" on Data logger PC should strictly be prohibited.

iii. Wireless keyboard and mouse should not be used on Data logger PC. If any such PC is using wireless keyboard and mouse using a bluetooth USB dongle, this may be replaced with the wired keyboard and mouse.

iv. It is recommended to use only genuine operating system and other software products in the system. It is suggested to install anti-virus software in the Data logger PC.

v. The officials must use username and password for accessing Data logger PC. It is advised that the password used may contain a mix of alpha, numeric and special characters. Employees should be sensitized and properly trained to keep passwords in secure manner.

vi. Unused ports should be disabled.

vii. Dedicated laptop shall be used for installation of software in Data logger.

viii. System documentation shall be maintained in station and it should have software and Hardware related information like version, revision. History, validation, checksum etc.

ix. The management of log data and its security must be assigned to an individual. A network administrator level official from Railways is suggested to monitor the activities at the Centralized Data logger room. Railways should maintain visitor records at data centres. In stations physical access to Datalogger room/Relay room should be restricted using key and key accessing logs to be maintained properly. It is suggested that access logs of Data logger room and Datalogger equipment should be maintained properly.

5 FUNCTIONAL REQUIREMENTS:

5.1 Each data logger shall have it's own identity code which shall be transmitted along with data packet to central monitoring unit.

5.2 Events recorded at each station shall be continuously transmitted to central monitoring unit. Response time of data transfer shall not exceed 10 seconds on voice channel & 2 seconds for E1 & ethernet.

5.3 In case of loss of data, retransmission of data shall take place.

5.4 ~~Data transfer rate shall be 115200 BPS for Ethernet with fallback facility to lower rates.~~

Data transfer rate shall be 10 MBPS/57600 BPS for the data communication with respect to the type of Media.

i. Data transfer rate shall be 57600 BPS with fall back facility for Voice Modem.
ii. Data transfer rate shall be 2MBPS for E1 and Dark fibre based on the network requirement.
iii. Data transfer rate shall be 10MBPS for Ethernet communication.

5.5 **EXCEPTION REPORT:**

The CMU shall generate the alarms as provided in the ANNEXURE- B7

5.6 Data loggers of all stations shall send status report to the Central monitoring unit continuously. Status information shall be processed at the central monitoring unit and audio- visual alarm generated for the fault / alarm condition.

6 TESTS AND REQUIREMENTS

6.1 Conditions of Tests

Unless otherwise specified all tests shall be carried out at ambient atmospheric conditions.

6.2 For inspection of material, relevant clauses of IRS: S 23 and RDSO/SPN/144 shall apply.

6.2.1 Test Equipment

i) Dual beam oscilloscope of 20 MHz bandwidth
ii) Digital multimeters - 3.1/2 digit display with facility of diode & transistor testing with 1% accuracy
~~iii) EPROM Programmer and UV eraser 5~~
iv) Megger (500V)
v) PC
vi) Test jig
vii) Any other test equipment considered necessary.

6.3 **Type Tests**

6.3.1 The following tests shall constitute type tests:

a) Visual inspection as per Clause 7.1
b) Insulation Resistance tests as per Clause 7.2
c) Card-level functional tests on all the cards.

d) System level functional tests.

e) Environmental/climatic tests as per Clause 7.3

f) Applied High Voltage Test as per Clause 7.4

6.3.2 Any other tests shall be carried out as considered necessary by the purchaser.

6.3.3 Only one equipment shall be tested for this purpose. The equipment shall successfully pass all the type tests for proving conformity with this specification. If the equipment fails in any of the type tests, the purchaser or his nominee at his discretion, may call for another equipment/card(s) of the same type and subject it to all tests or to the test(s) in which failure occurred. No failure shall be permitted in the repeat test(s).

6.4 **Acceptance Tests**

6.4.1 The following shall comprise acceptance tests:

a) Visual inspection (Clause 7.1).
b) Insulation Resistance tests (Clause 7.2).
c) System level functional tests.

6.4.2 Any other tests shall be carried out as considered necessary by the purchaser.

6.5 **Routine tests**

6.5.1 The following shall comprise the routine tests and shall be conducted by manufacturer on every equipment and the test results will be submitted to the inspection authority before inspection. The application software in proper format shall also be submitted to the inspection authority in advance.

a) Visual inspection (Clause 7.1)
b) Insulation Resistance tests (Clause 7.2)
c) Card level functional test on all the cards.
d) System level functional test.

6.5.2 Any other tests shall be carried out as considered necessary by the purchaser.

7 TEST PROCEDURE

The test procedure shall be based on the system design. The methodologies to be adopted for various tests shall be decided taking into account the system

design/configuration.

7.1 **Visual Inspection**

The equipment shall be visually inspected to ensure compliance with the requirement of Clauses 3 to 5 of this specification. The visual inspection will broadly include –

7.1.1 System level checking:

- Constructional details.
- Dimensional check .
- General workmanship.
- Configuration.
- Mechanical polarization on cards .

7.1.2 Card level checking:

- General track layout .
- Quality of soldering and component mounting.
- Conformal coating.
- Legend printing.
- Green masking.

7.1.3 Module level checking:

- General shielding arrangement of individual cards.
- Indications and displays.
- Mounting and clamping of connectors.
- Proper housing of cards.

7.2 **Insulation Resistance Test**

7.2.1 Insulation Resistance Test shall be conducted as per RDSO/SPN/144

7.3 **Environmental / climatic tests**

7.3.1 Environmental / climatic tests shall be conducted as per RDSO/SPN/144

7.4 **Applied High Voltage Test**

7.4.1 Applied High Voltage Test shall be conducted as per RDSO/SPN/144

8 QUALITY ASSURANCE

8.1 All materials & workmanship shall be of good quality.

8.2 Since the quality of the equipment bears a direct relationship to the manufacturing process and the environment under which it is manufactured, the manufacturer shall ensure Quality Assurance Program of adequate standard.

8.3 Validation and system of monitoring of QA procedure shall form a part of type approval. The necessary Plant, Machinery and Test instruments as given below shall be available with the manufacturer.

8.3.1 Plant & Machinery:

i) Ultrasonic cleaner/Aqueous cleaner for automatic cleaning
ii) Burn in chamber
iii) Anti-static assembly
~~iv) EPROM Programmer and UV~~
v) Microprocessor development system

8.3.2 All test instruments as given in Cl. 6.2.1 shall be available with the manufacturer.

8.4 Along with the prototype sample for type test, the manufacturer shall submit the Quality Assurance Manual.

9 PACKING

~~The equipment and its sub assemblies shall be packed in boxes/crate with suitable packing material and the empty spaces shall be filled with suitable filling material. Before keeping in the box/crate, the equipment shall be wrapped with bubble sheet. The equipment shall be finally packed in a wooden case of sufficient strength so that it can withstand bumps and jerks encountered in a road/ rail journey. Each box shall be legibly marked at one end with code numbers, contents, quantity and name of manufacturer/supplier. The upside shall be indicated with an arrow. Boxes should have standard signages to indicate the correct position and precautions "Handla with care" with necessary instruction.~~

The equipment and its sub-assemblies shall be packed in boxes/crate with suitable packing materials, and the empty spaces shall be filled with suitable filling material. Before keeping in the box/crate, the equipment shall be wrapped with bubble sheet.

The equipment shall be finally packed in a wooden case of sufficient strength so that it can withstand bumps and jerks encountered in a road/ rail journey.
Each box shall be legibly marked at one end with code numbers, contents. quantity and name of manufacturer/ supplier. The upside shall be indicated with an arrow. Boxes should have standard signages to indicate the correct position and precaution "**Handle with Care**" with necessary instructions.

10 INFORMATION TO BE SUPPLIED BY THE MANUFACTURER

Following documents should be supplied along with the system:

10.1 Mechanical drawings of each sub-system/ rack.

10.2 Trouble shooting chart.

10.3 Installation and Maintenance Manual.

10.4 Pre-commissioning check list, DOs and DON'Ts of data logger system including ~~RTU~~, CMU & FEP in the User's manual.

11 INFORMATION TO BE SUPPLIED BY THE PURCHASER

11.1 Total number of digital and analog inputs to be monitored calculated as under.

11.1.1 The tenderer should give number of digital inputs required by calculating the inputs from the list given below:

a) All ECRs,
b) All HRs, HHRs, DRs or equivalent
c) All point operating relays NWRs, RWRs or equivalent
d) All point indicating NWKRs, RWKRs or equivalent
e) All buttons and knob relays
f) All track and axle counter relays
g) All timer repeater relays
h) Intermediate interlocking relays which tenderer need to monitor through data-logger e.g. UCR, ASR, JSLR etc. or equivalent
i) All relays related with emergency operations e.g. route cancellation, overlap cancellation, point operation under emergency, crank handle release, gate release etc.
j) CH, GF, LX release and indication relays.

k) All relays related with block instruments with or without axle counters and SM key.

l) Any other relay required to be monitored.

11.1.2 Details of Analog inputs to be monitored in local area.

Type of input	No. of channels required
230 V AC	
110 V AC	
12 V AC	
110 V DC	
60 V DC	
24 V DC	
18 V DC	
12 V DC	
Any other voltage	

11.2 Additional exception reports (other than those mentioned in para 5.6) to be generated.

11.3 List of functions (in addition those mentioned in Annexure B1) to be monitored.

11.4 (a) Central monitoring equipment (CMU) required – Yes/ No.

(b) FEP required – Yes/NO

(c) Apps based messaging system required- Yes/No.

(d) Requirement of data transmission interface:

V.32 Modem for voice channel/E1 interface/ Ethernet interface/Media converters (Serial to Dark fibre)

(one or more to be selected)

11.5 Whether Dot matrix printer is required with data logger (at the station) : Yes/ No

11.6 Whether battery charger and battery required with data logger (at the station) : Yes/ No

12 WARRANTY AND AVAILABILITY REQUIREMENTS:

The Datalogger system including its equipment and subsystems such as FEP, CMU software, software, SERVER and modems shall be under warranty for

three years from the date of commissioning of complete system. However, purchaser can specify additional warranty if considered necessary.

Warranty of COTS items such as UPS, printer LAN switches etc shall be as per warranty provided by the respective manufacturer.

Requirement of spare parts of each type for the first line maintenance shall be indicated for better system availability.

The MTBF of all vital modules shall be more than one lac hours. System availability (Operational Availability of complete system, including power supply, wiring etc.) shall be 99.98% or better. The supplier to give the detailed calculation to achieve this.

Annexure-A

Data Logger Network and Data & Communication Protocol

Scope

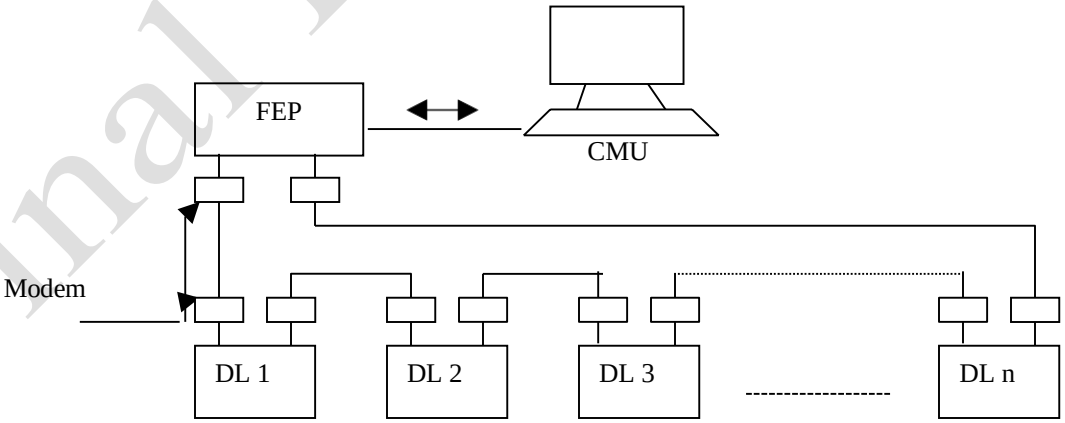
This Document details out the communication methods and protocols for data logger data transportation . These methods and protocols are independent of the hardware of the data logger. The communication methods and protocols have been designed to bring out the maximum throughput from the network.

Overview

The data structure protocol for communication between the data loggers and CMU is explained in paras A.4, A.5 and A.6 of this Annexure.

A1. Network Topology of Data logger with serial communication with voice modem:

Ring Network topology has been adopted in this network. In Ring configuration the Data loggers are connected serially one to another. If 'n' number of Data loggers are in network then the first Data logger is connected to the second Data logger and second Data logger to third Data logger so on up to the 'nth' Data logger. Then the first and 'n th ' Data loggers will be connected to the Front End Processor (FEP) individually to make the network as closed ring. Each Data logger is connected with other Data loggers in either direction with 4 wire leased line modems. FEP is also connected through the modems to the first and last Data loggers. Since this type of configuration gives individual one to one communication between Data loggers, so event data can be placed into network immediately and simultaneously by all the Dataloggers.



Data Logger System Network

Direction A is data flow from Data logger n,n-1,…..1 - FEP.
Direction B is data flow from Data logger 1 ,2,……n -FEP.

Note: To improve data transmission speed to central location, E1 channel can also be used with necessary converter/Data framer. Typical arrangement is given in **Annexure B2 (B).**

A2. Network Topology of Ethernet compatible Data logger over MPLS Network:

i. Data logger senses and time stamps parameters of signaling elements as events with serial number and Datalogger equipment ID. The data events generated by data loggers at cabins / gumties at stations and LC gates, IBSs and Auto signals in block sections are aggregated by station data logger – through network system based on daisy chain topology.
ii. Dataloggers data on Ethernet will be sent on MPLS network through L3 LAN switch available at station.
iii. CMUs connected to the data logger networks, receives the data of all data loggers, validates, analyses and generates alarms. CMUs sends the data and alarms to redundant servers for further user access.
iv. CMU eliminates the redundant data and posts the data of events and alarms into two servers.
v. Data can be displayed for analysis in Data logger maintenance center for real time monitoring and analysis.
vi. Alarms are sent as notifications to mobile users
vii. Events, alarms and simulation can be viewed from mobile, tablet and PCs
viii. **Server** plays vital role in making the data available for multiple agencies simultaneously. Old data is stored in it for analysis. A standby server is to be provided to ensure availability of data in case of failure of hardware or software.
ix. Data logger data has to be made available to all the concerned officials like zonal office and field supervisors on real time basis to enable them to take actions in case of accidents or incidences. Viruses are likely to affect the systems provided in the test room. To avoid the same, it is recommended to provide **fire wall with redundancy**.
x. Data can be extended to **intranets like RAILNET** from the LAN Switch after the Firewall.
xi. Option of keeping the data in the cloud shall be exercised progressively to save the resources and ensure the reliability of data availability.
xii. In case the data is kept on cloud – data can be shared by divisional, zonal and railway board users directly from the cloud. Until such time, to provided data access to different users, connectivity to the server has to be planned. The following is one such option.
xiii. In the Test Room, one screen shall be provided to CMU PC for monitoring Data Logger network and another **bigger screen** shall be provided to for reports of station and **failure display.** One big screen of up to 42 cm shall display each station as a rectangle box of proper size. Status of station signaling, power supply and relay room on real time basis by changing the colors of the rectangle box which can be seen from a distance by anyone in the test room.

For example, if a point fails at a station the rectangle turns to red – red disappears as soon as the monitoring person acknowledges it. For the detailed working the report of the working committee may be seen.

xiv. One medium size screen may be provided to display the status of data logger network.

xv. Schematic architecture of networking of Ethernet compatible Data logger and Zonal office setup are given in Annexure-B2 & B3.

Port for connectivity at Datalogger

(i)	Mode:	Asynchronous
(ii)	Baud:	115200bps
(iii)	Character Length:	8 bits
(iv)	Parity:	none
(v)	Stopbits:	1

A3. Message Formats

Two types of message formats have been implemented. One for Commands from CMU to any Data Logger / FEP and other is for event packets transmission in the network.

Commands.

Between CMU and Data Logger / FEP

CMU Data Logger/FEP

(a) Request Respond

Request ⟶ Accept request

Accept response ⟵ Send response

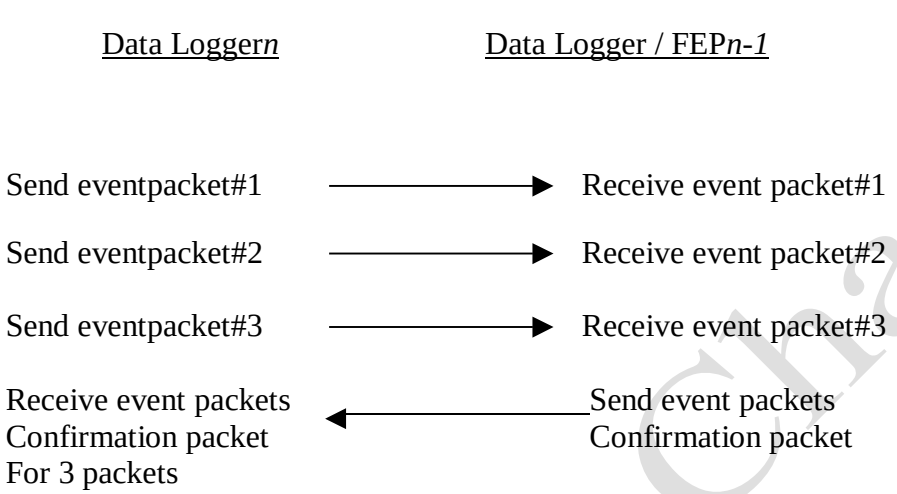
(b) Send all get Reply

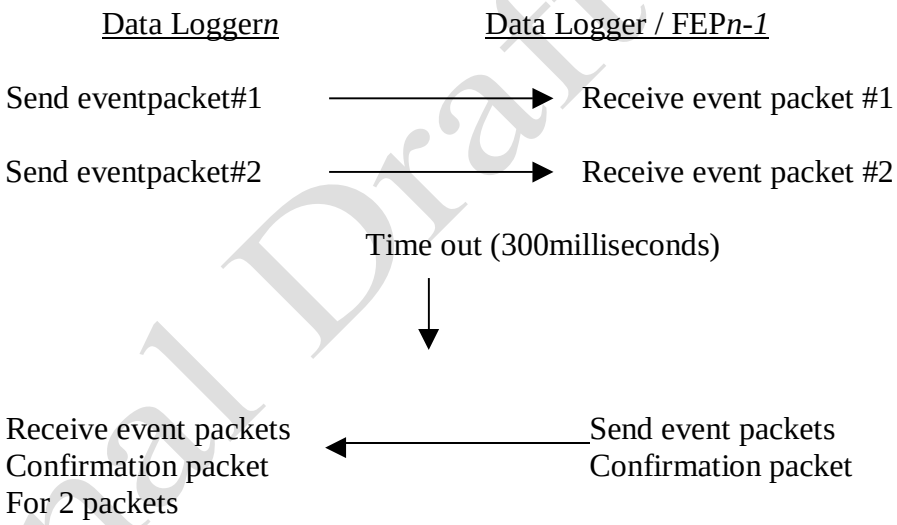
Broadcast request ⟶ Accept Broadcast request

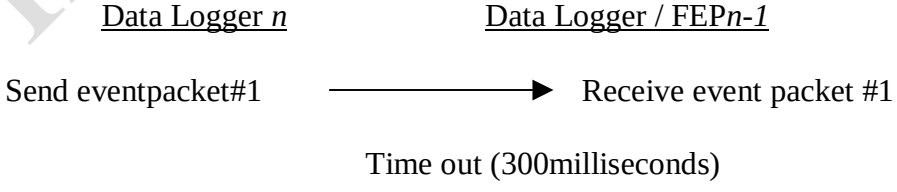
Accept reply ⟵ Reply from all

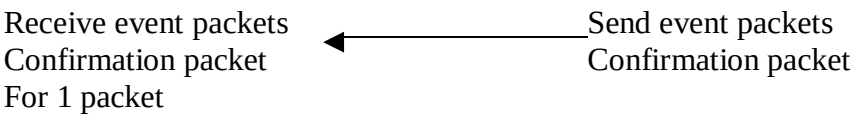
A4.Event Packets.

Between two Data Loggers or Data Logger and FEP.



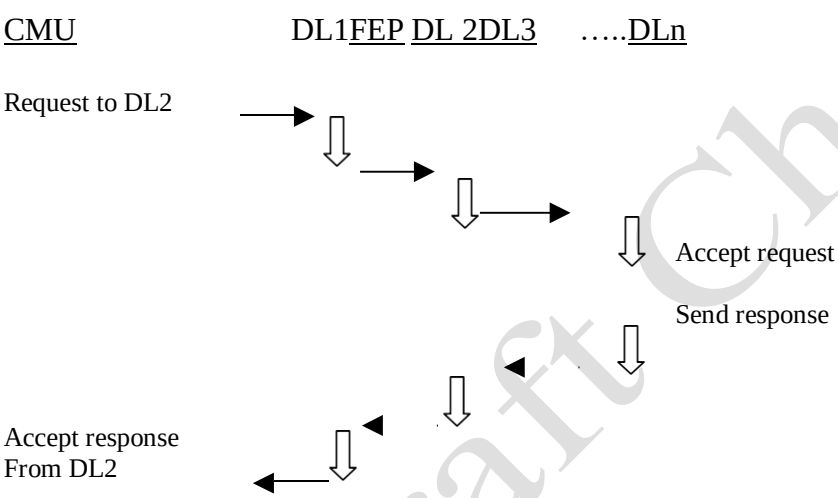






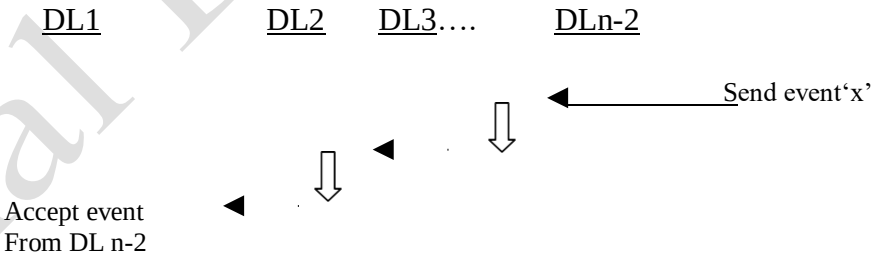
Command and Event Flow

Command flow for request-respond

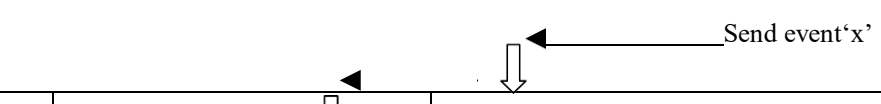


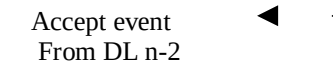
Packet flow for event data in two directions

Direction I



Direction II





⇩ = Retransmission to the next Data Logger in the other direction.

Event Packets Communication:

The event packets created in the DL will be sent immediately in both the directions. The event packets received from one direction is retransmitted to the other direction. The event packet is maintained in the buffer till it is acknowledged.

On failure of acknowledgement the event packets are tried again for transmission after the time out of 3 Seconds.

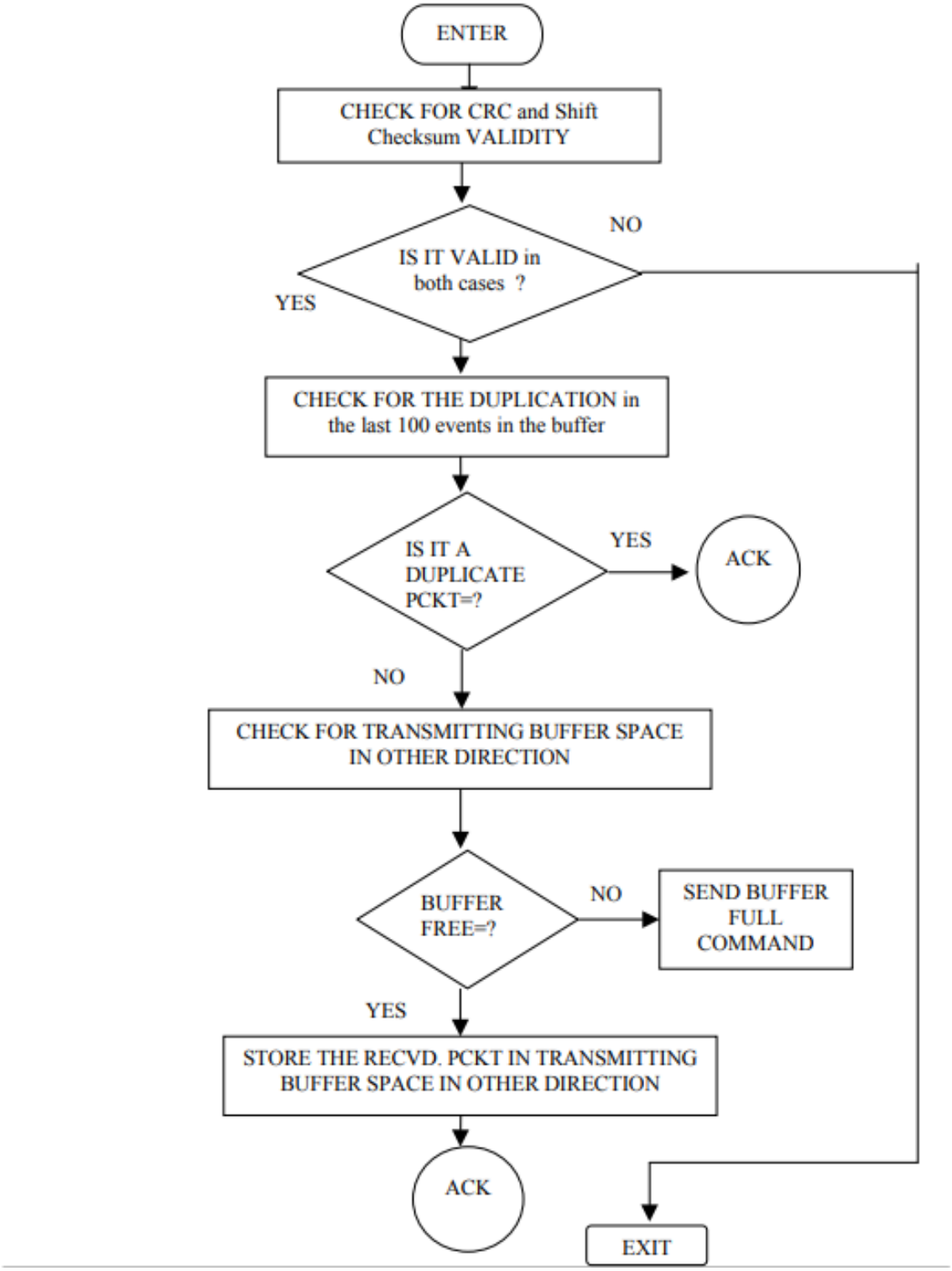
This is repeated and tried for three times with the same time-out of 3 Seconds. If acknowledgment is not received even after three trials, then time-out will be changed to 120 Seconds, thereafter it will be tried every 120 Seconds till it is acknowledged.

The acknowledgement for the event packets are sent for every three event packets received or if the time between received packet exceeds 300 milliseconds.

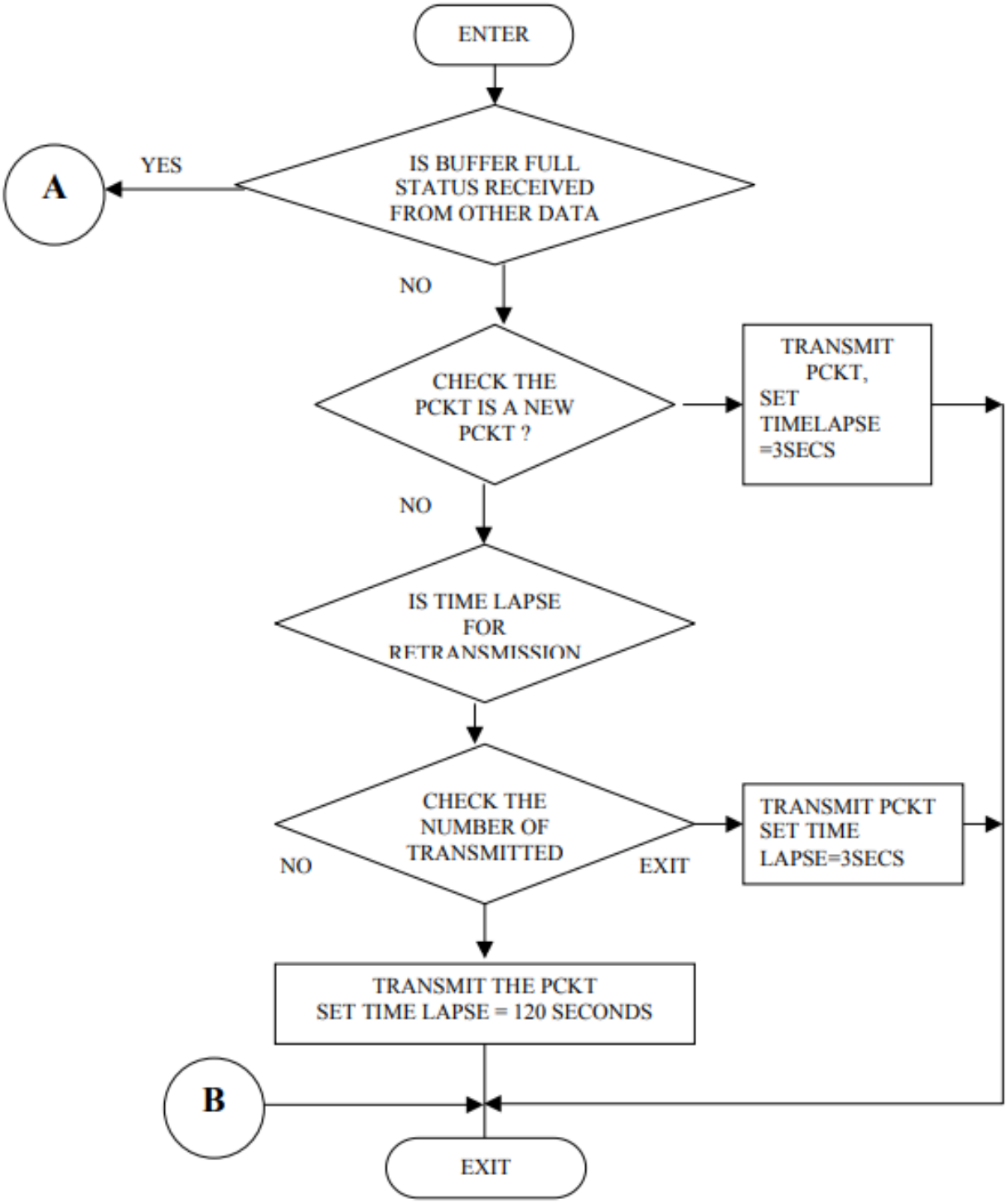
On receiving any event packet it is validated for CRC and Shift Checksum. If validity fails, no action is performed. For valid packets Data Logger will check for any duplication within the last 100 packets. If it is a duplicate packet then acknowledgement will be given but it will not be transmitted in the other direction. If it is a new packet then it will be placed in the buffer if space is available and acknowledge is sent back. If space is not available then buffer full command is sent back. Once the space is available then buffer free command is sent to reinitiate the packets transmission.

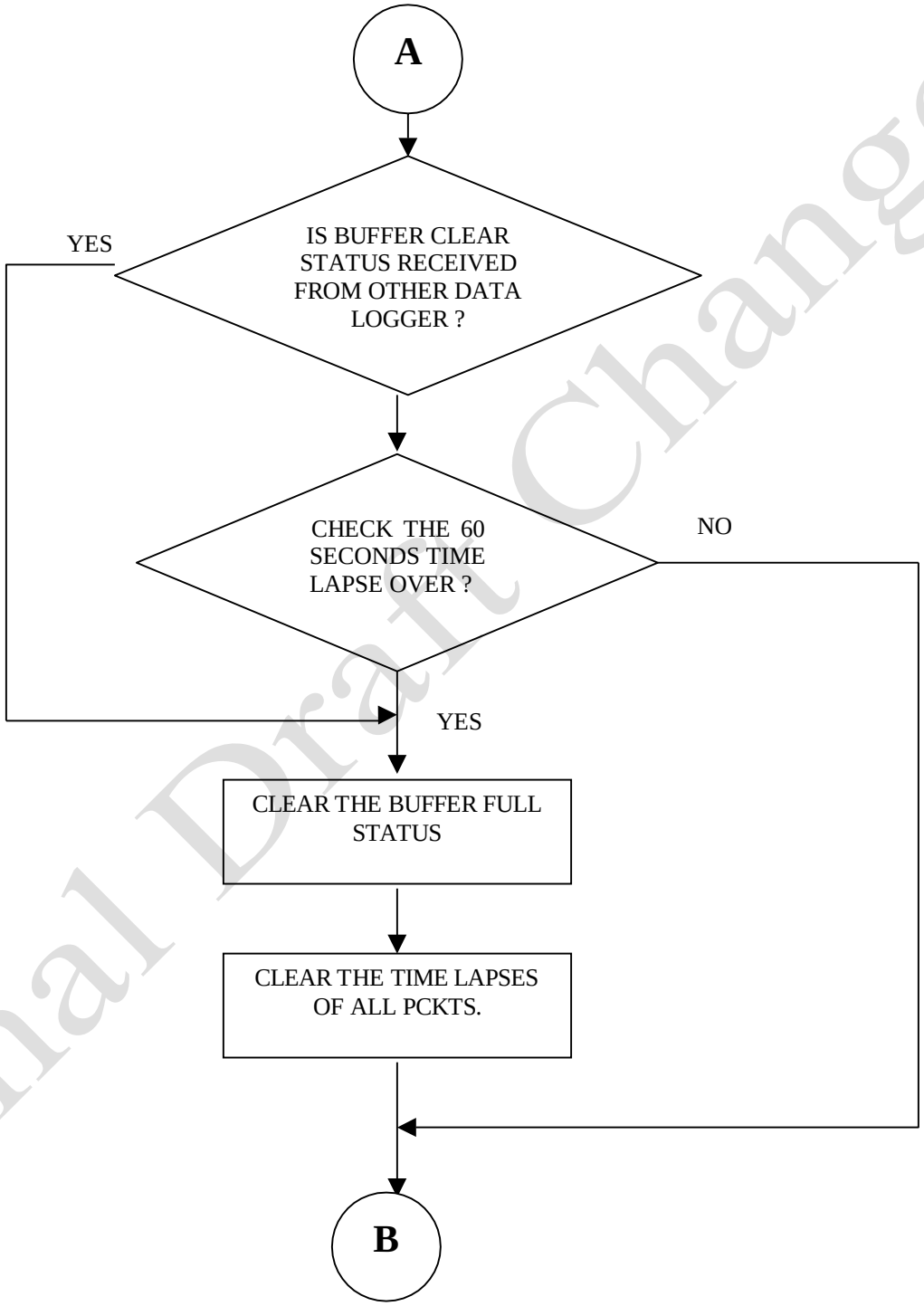
Once buffer-full command is received back for packet transmission then the Data logger will set itself to buffer full status and wait for a time lapse of 60 Seconds. On receiving the status of buffer free, the Data Logger will clear the buffer-full status and time lapses counts to initiate the transmission of packets.
At FEP, the received event packets from both the directions are buffered. These data will be sent to CMU whenever request received from CMU. Till then it is stored in buffer.
These processes are illustrated with flow diagrams given below.

A.3.3.4 Received Event Packet Processing

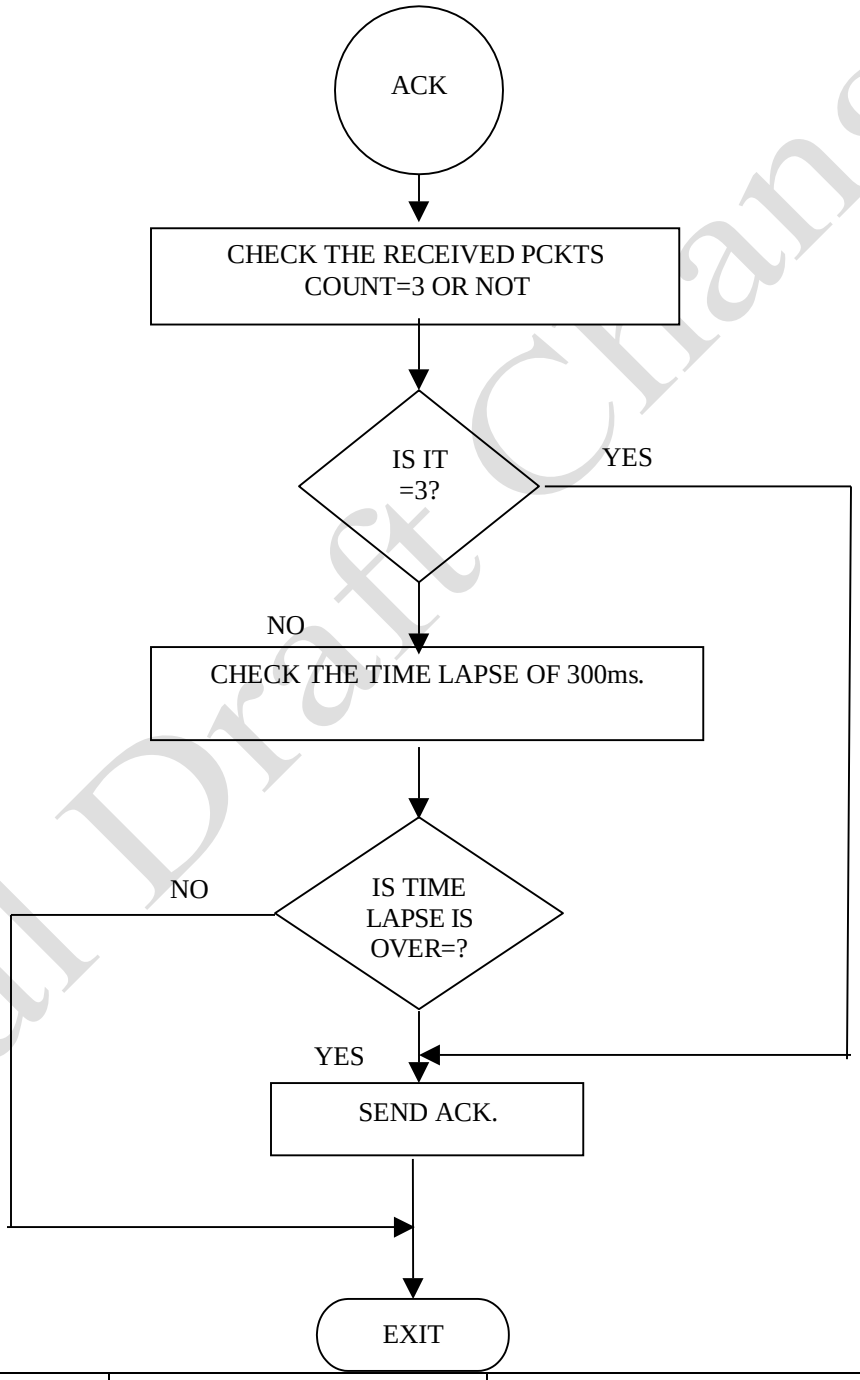


A.3.3.5 Event Packet Transmission Process





Acknowledgement Process for Event Packet

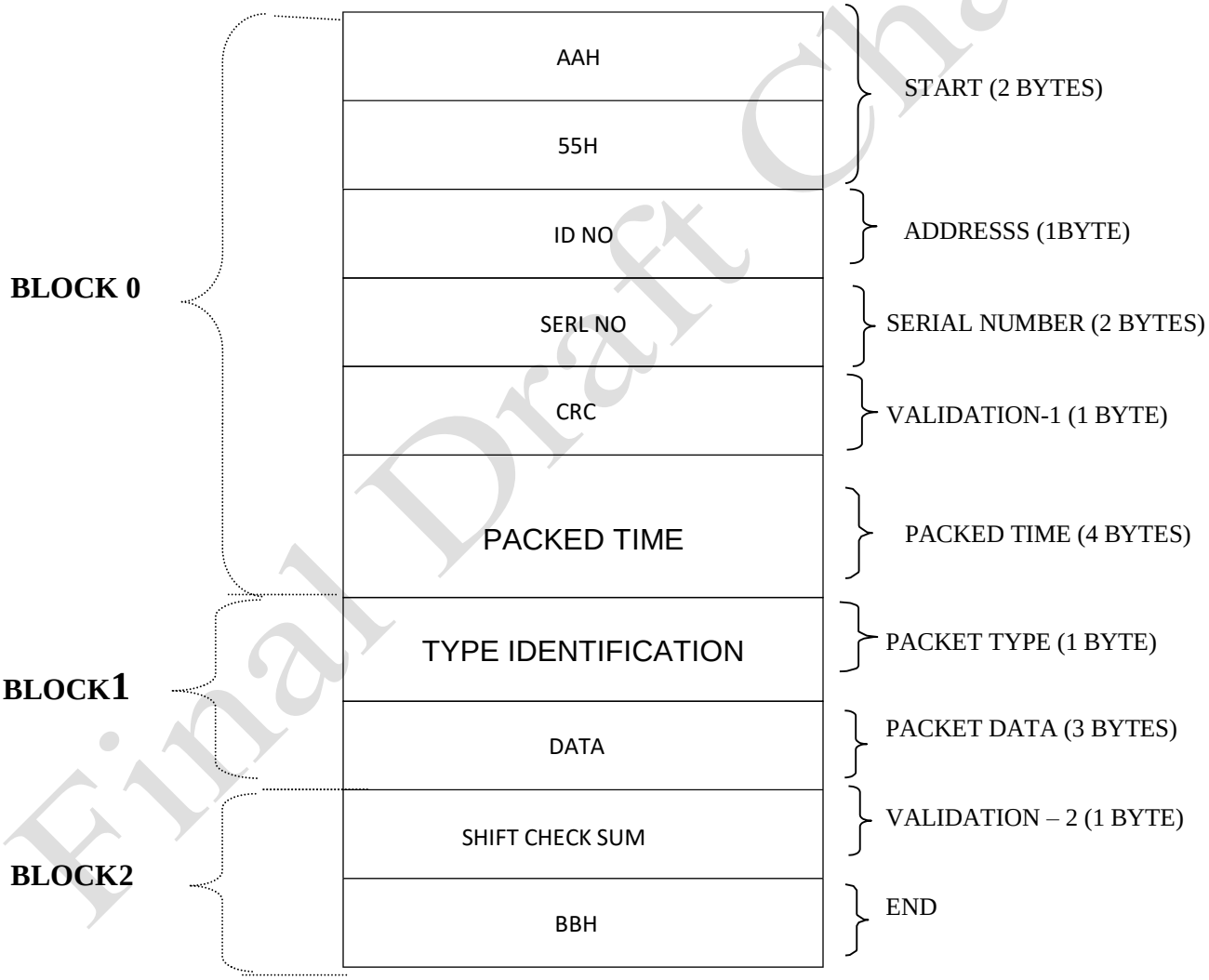


Commands Communication:

Commands always originated from the CMU to facilitate control actions on any one or all the Data Logger/s in the network. Buffer full and Buffer free commands are the only commands originated by Data Loggers for control of event packets flow. The commands always work in the Request and Response style.

A4. EVENT PACKET

EVENT PACKET FORMAT



Event packet consists three blocks as shown in the above frame format.

i) Block 0
ii) Block 1
iii) Block 2

BLOCK 0: The size of the BLOCK 0 is 10 bytes. The structure of Block 0 is common for any type of event packet and it is having the following five fields.

Field Name	Size in bytes
START	**2**
ID Number	**1**
Serial No.	**2**
CRC	**1**
Packed Time	**4**

START: $AA and $55 are the start of the event packet.

ID NO: This is used for the identification of various devices like FEP, DATALOGGER and RTU.

The ID numbers allotted for each device is listed below.

DEVICE	ID RANGE
FEP	00H
~~RTU~~ DATALOGGERS	01H - ~~40H~~FEH
~~DATALOGGERS~~ CMU	~~41H – 7FH~~FFH

Note: The ID numbers range from 80H to FFH are reserved.

Serial Number: It is the sequence number of packet. With this CMU will identify that it is receiving all the packets or not. Serial no will start from 0000H, when ever a packet is created count will be incremented by one, and will roll over to 0000H after reaching FFFFH.

CRC : This is a validation byte provided for the 11 bytes in the data packet from ID No to DATA fields.

Calculation of CRC byte:

Calculation of CRC byte using Microprocessor is time-consuming process. So look up table technique is being used. The lookup table will be prepared for all the combinations of words (16 bits each word). The total possible combinations are 65536 (0000H to FFFFH). So total 64K bytes of lookup-table is needed.

Calculation of the CRC byte for all 11 bytes as follows:

	MSB	LSB	RESULT
1	ID No	Serial No MSB	CRC1
2	CRC1	Serial No LSB	CRC2
3	CRC2	Time-1	CRC3
4	CRC3	Time-2	CRC4
5	CRC4	Time-3	CRC5
6	CRC5	Time-4	CRC6
7	CRC6	Type identifier	CRC7
8	CRC7	Data-1	CRC8
9	CRC8	Data-2	CRC9
10	CRC9	Data-3	CRC10

The CRC10 will be the CRC field in event packet.

Time-1, Time-2, Time-3 and Time-4 are 4 bytes of packed Time filed from MSB to LSB respectively.

Data-1, Data-2 and Data-3 are 3 bytes of DATA field from MSB to LSB respectively.

First word will be framed by taking ID no as MSB and Serial No MSB as LSB. For this word the CRC byte will be taken from CRC lookup table is mentioned as CRC1 in the above table.

Second word will be framed by taking this resultant CRC byte (CRC1) as MSB and Serial No LSB as LSB. For this word the CRC byte will be read from CRC lookup table is mentioned as CRC2 in the above table.

This process will be repeated for 10 times as shown in the above table, the resultant byte (CRC10) is the final CRC. This will be placed in the event packet as CRC.

PACKED TIME:

Time will be stored in the Packed Form. This is a long word size and time will be calculated in multiples of 1/64 second. This long word will hold time for one year and even/odd year identification. In the long word least 31 bits will represent the time. The 32nd bit will be used to represent the year status, '1' for odd year and '0' for even year.

The equation to build packed time from the real time is given below.

Packed time = (Days x 24 x 60 x 60 x 64) + (Hr x 60 x 60 x 64)+(Mt x 60 x 64) + (Sec x 64).

Here Days = Number of completed days till present date
Hr =Hours
Mt = Minutes
Sec = Seconds

Example: Consider 12th March 2003, 21:16:24

Days = 70
Hr =21
Mt = 16
Sec = 24

Packed Time=(70*24*60*60*64+21*60*60*64+16*60*64+24*64)
= 391973376 decimal / 175D0A00 hexa

BLOCK1:

Block 1 size is 4 bytes. The values in the BLOCK 1 will vary depending upon the type of event packet. BLOCK1 is having the following fields.

a) TYPE IDENTIFIER (1bytes)
b) DATA (3bytes)

TYPE IDENTIFIER (TI):

This is a byte-sized value and it indicates packet type. Each packet will have a unique type identifier. The below table shows various type identifiers.

TI	Details	USAGE
00H	Digital Record	Compulsory
01H	Analog Record	Compulsory
02H	Time Difference	Compulsory
03H	Time Write Low	Compulsory
04H	Communication Status Packets	Optional
05H	Health Record	Compulsory
06H	Periodical All Inputs Status	Compulsory
07H	All Inputs Status at Reset	Compulsory
08H	Reserved	
09H	Configuration Record	Optional
0AH	Time Write High	Compulsory
0BH	Reserved	
0CH	Reserved	
0DH	Digital Fault	Optional
0EH	Analog Fault	Optional
0FH	Reserved	
10H	Digital Chattering On	Compulsory
11H	Digital Chattering Off	Compulsory
12H	Modem Link Status	Compulsory
13H	Reserved	
14H	Reserved	
15H	Reserved	
16H	Reserved	
17H	Reserved	

DATA:

This field is having 3 bytes and the structure of these bytes will vary depending upon packet. All the packets are explained in the following sections.

BLOCK2:

BLOCK 2 size is 2 bytes. The structure of Block 2 is common for any type of event packet and it is having the following two fields.

Field Name	Size in bytes
Shift Checksum	1
End (BBh)	1

SHIFT CHECKSUM:

This is also a validation byte provided for the 11 bytes in the data packet from ID No to DATA fields excluding CRC.

Calculation of SHIFT CHECKSUM byte:

In the calculation process, each byte in the record structure (leaving the CRC byte) will be rotated to left by one bit and then these bytes will be summed up to form the 'Shift checksum byte'.

It is explained in the given below example.

Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7	Byte8	Byte9	Byte10	Byte11	Byte12
48H	00H	31H	10H	90H	00H	C2H	13H	87H	FFH	FFH	31H

Byte 4 is CRC which is excluded in calculation.

CALCULATION

	Actual value (in Hex)	Actual value (in Binary)	Rotated by 1 value (in binary)	Shifter by 1 value (in hex)
Byte 1	48H	0100 1000	1001 0000	90H
Byte 2	00H	0000 0000	0000 0000	00H
Byte 3	31H	0011 0001	0110 0010	62H
Byte 5	90H	1001 0000	0010 0001	21H
Byte 6	00H	0000 0000	0000 0000	00H
Byte 7	C2H	1100 0010	1000 0101	85H
Byte 8	13H	0001 0011	0010 0110	26H
Byte 9	87H	1000 0111	0000 1111	0FH
Byte 10	FFH	1111 1111	1111 1111	FFH
Byte 11	FFH	1111 1111	1111 1111	FFH
Byte 12	31H	0011 0001	0110 0010	62H

Shift checksum or Resultant byte = 2DH

END: It is the Event packet END identifier.

DIGITAL RECORD:

This record will be created to indicate the change in status of the digital input.

Occurrence: This record will be created whenever a digital input changes its state (From ON to OFF or OFF to ON). Its record ID is **00H.**

BLOCK 0
BLOCK 1 **TI - 00H (1Byte)**
INPUT NUMBER(2Bytes)
STATUS OF INPUT (1Byte)
BLOCK 2

INPUTNUMBER: 1 TO 4096
STATUS OF INPUT: 00h PICK UP
FFh DROP

ANALOG RECORD:

This record will be created whenever there is variation in the any of analog inputs.

Occurrence: This record will be created whenever the difference of previous recorded channel value and present scanned channel value of a particular input crosses the configured tolerance limit.

BLOCK 0
BLOCK 1 **TI - 01H (1Byte)**
CHANNEL VALUE(2Byte)
CHANNEL NUMBER (1Byte)
BLOCK 2

CHANNEL VALUE :0 TO 4095 (Value 4095 is equivalent to Maximum possible Channel value for that input). The nominal voltages and their corresponding maximum voltages are shown in the belowtable.

Nominal voltage	Maximum voltage	Maximum value
230V AC	330V AC	4095
110V AC	170V AC	4095
110V DC	170V DC	4095
60V DC	90V DC	4095
24V AC	50V DC	4095
24V DC	50V DC	4095
18V DC	50V DC	4095
12V DC	25 VDC	4095
6V DC	10V DC	4095

CHANNELNUMBER: 1 TO96

The temperature record will also be created with the same analog record ID with channel number as 00h. The channel value MSB made 00 and LSB gives the temperature measured.

TIME DIFFID:

To notify the difference between the packed time and with RTC chip time.
Occurrence: This record will be created whenever there is a difference in packed time and RTC chip time. The data logger compares the chip time with the packed time periodically and to record the difference if any

BLOCK 0
BLOCK 1 TI - 02H (1B)
STATUS BYTE (1B)
DIFFERNCETIME VALUE (2B)
BLOCK 2

STATUS BYTE:

00H if RTC Time > Packed Time
FFH if RTC Time < Packed Time

DIFFERNCE TIME VALUE: RTC Time ~ Packed Time

TIME WRITE:

This record will be created whenever time set command was sent from CMU.

Occurrence: This record is created whenever time was set from CMU, two records were created, one for lower 3 bytes and another for upper 3 bytes of packed time that has been sent from the CMU. These two records differ in record Id, for the lower 3 bytes it is 03H. For the higher three bytes it is **0AH.**

BLOCK 0
BLOCK 1 **TI - 03h / 0Ah (1Byte)**
Set Time (3Byte)
BLOCK 2

Communication Status Packets:

These records were created to log network status for later analysis. the network communication health status.
Occurrence: These records will be created for every 68 minutes approximately.

BLOCK 0
BLOCK 1 **TI - 04H (1B)**
PACKETS COUNT (2B)
SERIAL NUMBER (1B)

BLOCK 2

PACKETCOUNT:
Transmitted packets (or) Received packets (or) Pending packets (or) Duplication packets (or) Fail packets for two network ports.

SERIAL NUMBER: It specifies the type of Packets count.

Serial Number	Details
01h	Transmitted Packets Count (Direction-A)
02h	Receive Fail Packets Count (Direction-A)
03h	Pending Packets Count (Direction-A)
04h	Received Packets Count (Direction-A)
05h	Transmitted Packets Count (Direction-B)
06h	Receive Fail Packets Count (Direction-B)
07h	Pending Packets Count (Direction-B)
08h	Received Packets Count (Direction-B)

0dh	Duplication Packets Count (Direction-A)
0eh	Duplication Packets Count (Direction-B)

HEALTHRECORD:
This record will be created to notify the health of data logger to the CMU.
Occurrence: This record will be created for every one minute if any other record is not created.

BLOCK 0
BLOCK 1 **TI - 05H (1B)**
DUMMY BYTES (3BH)
BLOCK 2

DUMMY BYTES**:** 00H

Periodical All Inputs Status:

In these records the status of all the digital inputs will be sent. So as the CMU can synchronize with the latest input status.

Occurrence: These records are created for every 34 minutes approximately and also on request of the CMU. The number of records created will depend upon the number of inputs configured. In each record, status of 16 inputs will be sent. Each inputs status can be 0 or 1(‘0’ for pickup and ‘1’ for drop). If the number of inputs configured is 512, 32 records will be created. The configuration should be in the multiples of 512 inputs. The 1st record will have inputs of 1 to 16, 2nd record will have 17 to 32 and so on up to the total number of inputs.

BIT	B15	B14	B13	B12	B11	B10	B09	B08	B07	B06	B05	B04	B03	B02	B01	B00
IP NO	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1

BLOCK 0
BLOCK 1 **TI - 06H (1B)**
STATUS (2B)
SERIAL NUMBER(1B)
BLOCK 2

STATUS: Status of a set of 16 inputs

SERIAL NUMBER:00h-FFh

For the first 1 to 16 inputs 00h is given as serial number and continued up to FFh for the inputs 4096.

All Inputs Status At RESET:

These records have been created at the time of Data Logger Reset. This is identical to the **Periodical All Inputs Status** except the type identifier.
Occurrence: These records will be created when ever the data logger resets.

BLOCK 0
BLOCK 1 TI - 07H (1B)
STATUS (2B)
SERIAL NUMBER(1B)
BLOCK 2

Configuration Record:

This record will be created to store the all configurations of the Data Logger.

Occurrence: This record will be created whenever data logger is reset/powered on. This record will also be sent for every 34 minutes along with the Periodical all input status packets.

BLOCK 0
BLOCK 1 TI - 09H (1B) CONFIGURATION BYTES (3B)
BLOCK 2

CONFIGURATION BYTES:

Byte1: Higher nibble (B7-B4) contain version value
Lower nibble will give Revision value.

Byte2: Bit 7 is not used.

Bit 6 is not used.
Bit 5 is not used.

Bit 4 is to indicate whether analog channels are enabled or not.
If '0' , analog channels are disabled.
If '1' , analog channels are enabled.

Bit 3 is not used .

Bits B3,B2,B1, B0 will indicate the digital inputs configuration.

B 3	B 2	B1	B 0	Number of digital inputs configured
0	0	0	0	512
0	0	0	1	1024
0	0	1	0	1536
0	0	1	1	2048
0	1	0	0	2560
0	1	0	1	3072
0	1	1	0	3584
0	1	1	1	4096
1	0	0	0	128
1	0	0	1	192
1	0	1	0	256

Byte3: Reserved

DGTLFALT_RECID:

This record will be created whenever the digital fault sequence occurs.
No specific data format is defined since the digital fault sequence is dependent on local PC.
Occurrence: This record is created, whenever the predefined sequence of operations will occur.

BLOCK 0
BLOCK 1 TI - 0DH (1Byte) DATA (3Bytes)
BLOCK 2

ANLGFALT_RECID:

This record will be created to indicate that the analog channels exceeded configured safe limits.

Occurrence: This record is created whenever an analog channel crosses the configured minimum or maximum channel limits.

This record identical to analog record except type identifier.

BLOCK 0
BLOCK 1 TI - 0EH (1Byte) CHANNEL VALUE (2Bytes) CHANNEL NUMBER (1Byte)
BLOCK 2

CHANNELVALUE: 0 TO4095.

CHANNEL NUMBER: 1 TO ~~64~~96

B7- '1' THEN FAULT IS DUE TO EXCEEDING MAX. VALUE
'0' THEN FAULT IS DUE TO FALLING BELOW MIN. VALUE
B6 TO B0 – INDICATE THE CHANNEL NUMBER.

CHTRON_RECID:

This record is created whenever any relay is chattering.

Occurrence: This record will be created whenever digital input changes from NORMAL state to CHATTERING state.
A digital input is said to be in chattering state, if its status changes by 8 times or more in 4 seconds. Normal state is the state where the input status does not change so.

BLOCK 0
BLOCK 1 **TI - 10H (1Byte)** **INPUT NUMBER (2Bytes)** **INPUT STATUS (1Bytes)**
BLOCK 2

INPUT NUMBER :01 TO 4096

INPUTSTATUS: No significance

CHTROFF_RECID:
This record is created whenever any relay is normalized from chattering.

Occurrence: This record will be created whenever digital input changes from CHATTERING state to NORMAL state.

BLOCK 0
BLOCK 1 **TI - 11H (1Byte)** **INPUT NUMBER (2Bytes)** **INPUT STATUS (1Byte)**
BLOCK 2

INPUT NUMBER :01 TO 4096

INPUT STATUS:

00H- PICKUP
FFH- DROP

Modem Link Status

This record will be created whenever the modem establishes or losses the link with the other modem.

Occurrence: This record will be created whenever 'Carrier Detect' bit of the modem changes its state.

BLOCK 0
BLOCK 1 **TI - 12H (1Byte)** **CD STATUS(1Byte)** **PORT NUMBER (1Byte)** **00H (1B)**
BLOCK 2

PORT NUMBER :

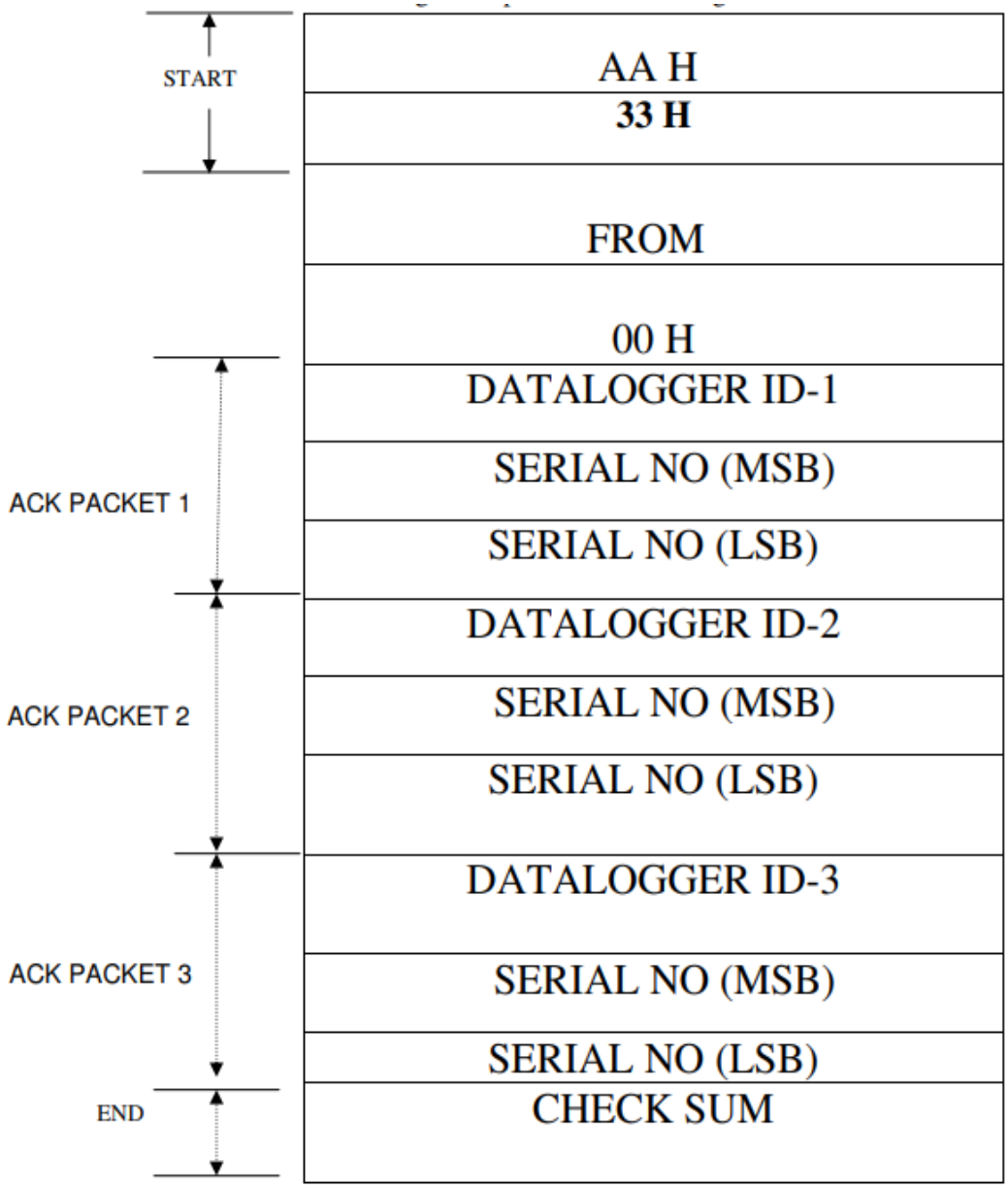
01H- Direction A
02H- Direction B

CD STATUS :

00h- 'CD' NOT EXISTING
FFh- 'CD' EXSISTING

A5. ACKNOWLEDGEMENT PACKET

The Acknowledgement packet structure is given below.



START: AAH, 33H are the start identifiers.

FROM: Indicates the data logger ID from which the acknowledgement is sent.

DATALOGGER ID-1: Signifies the DL-ID in the first event packet received.

DATALOGGER ID-2: Signifies the DL-ID in the second event packet received.

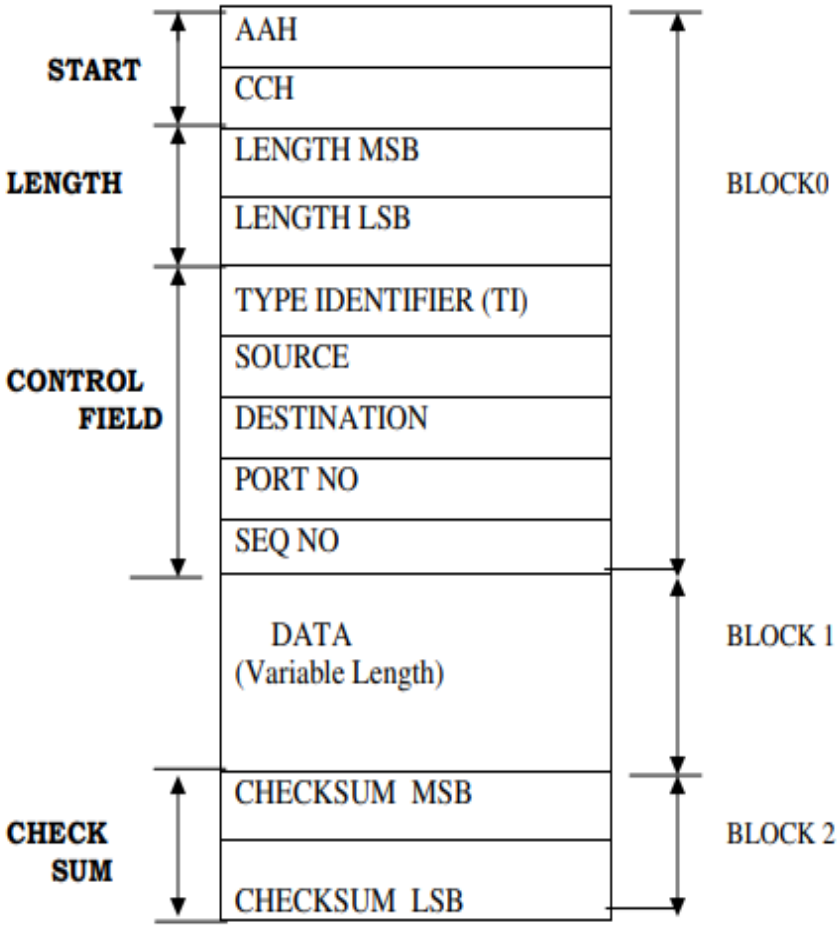
DATALOGGER ID-3: Signifies the DL-ID in the third event packet received.

SERIAL NO: Signifies the serial number in the received event packet.

CHECKSUM: Signifies the validation Byte for this acknowledgement packet. It is the 2's complement of modulo sum of the 11 bytes from "FROM" field to Serial Number LSB of third event packet.

The length of the frame is always fixed to 14 bytes in spite of the number of event packets received are less than 3 also. In that case the other acknowledges are filled with'00h'.

A6. Command Format



A.6.1 BLOCK0:

START: Every command frame will be started with these two identifiers. The identifiers are

1. AAH
2. CCH

LENGTH: The LENGTH is represented in two bytes as 16-bit value. It defines the no. of bytes in between Type identifier(TI) and Checksum Lsb
Inclusive of both.

CONTROL FIELD:

A. TYPE IDENTIFIER, B. SOURCE, C. DESTINATION, D. PORT NO,
E. SEQ NO

A. TYPE IDENTIFIER(TI):

Type Identifier will represent different commands. Also it represent the acknowledgement by OR with 40h for the command received.

Type Identifier Range	Details
00h - 7Fh	Reserved
80h - BFh	Commands
C0h - FFh	Acknowledgements

B. SOURCE:

This byte signifies from where the command is originated.

C. DESTINATION:

This byte indicates the destination to where the command has to reach.

For above two control bytes the identifications are

i. CMU: The identification for CMU was FFh
ii. FEP: Identification for FEP was00h
iii. DL: Identification range was 41h to7Fh

For any command, If the destination byte is 'FFH', then that command will be treated as a Global command.
Whenever a data logger receives a command, it will check the destination byte for FFH, if it is FFH, then it will serve the command and will send it to next data logger.
If the destination byte is not FFH, then the data logger will check it with it's own ID. If it found to be equal then it will serve the command. If it is not equal, then it will send that command to the next data logger.

D. PORTNO:

CMU can send the command in any direction/s by placing '1' in the relevant bit/s in the field.

Byte structure:

Bit pos	B7	B6	B5	B4	B3	B2	B1	B0
Value	0	0	0	0	0	Port3	Port2	Port1

- 1 – Selection ofport
- 0 – Ignoring of port

E. SEQUENCENO:

This byte is generated by the CMU. And CMU anticipates the same byte should be echoed in the acknowledgement command, other wise CMU treats acknowledgement as invalid.

Type-Identifiers:

Type-Identifiers	**Command**	**Description**
80H	Link check	For checking link in b/w CMU & DL.
81H	Data Request	Request DL for Data in Stand alone mode. Ignored in network ports.
82H	Upload result	Ack. To the above Data Request Command.
83H	Read Time	Read time from DATA LOGGER
84H	Write Time	Writing time into DATA LOGGER
85H	Buffer Free	Buffer free between Data Loggers
86H	Reserved	
87H	Reserved	
88H	Reserved	
89H	Reserved	
8AH	Reserved	

8BH	All I/P Status	Request For Creating All inputs Records
8CH	Modem reset	Request For Modem Reset (Res)
8DH	Reserved	
8EH	Reserved	
8FH	Buffer full	Buffer full between Data Loggers
90H	Set transmitting pointer	For setting the Transmitting pointer of the required port to the required record.
91H	Receive relay status	Requesting 1-8 relay status from data logger
92H	Send relay status	Sending 1-8 relay status to the data logger
93H	Receive relay status	Requesting 9-16 relay status from data logger
94H	Send relay status	Sending 9-16 relay status to the data logger
95H	Reserved	

Link check:

BLOCK 0 TI – 80H RECORD LENGTH = 07H
BLOCK 1 **{No DATA BYTE is available}**
BLOCK 2

Acknowledgement for Link Check:

BLOCK 0 TI – C0H RECORD LENGTH = 07H
BLOCK 1 {No DATA BYTE is available}
BLOCK 2

Data Request:

BLOCK 0 TI – 81H RECORD LENGTH = 07H
BLOCK 1 **{No DATA BYTE is available}**
BLOCK 2

This command is used to receive event records of the Data Logger in to local PC.

Acknowledgement for DATA REQUEST:

BLOCK 0 TI – C1H RECORD LENGTH = N+07H
BLOCK 1 (N Bytes) **{Length is Variable}**
BLOCK 2

In the acknowledgement frame Data Logger can send event data of 10 records maximum to local PC. Event packets are identical with 12 bytes in length as specified in event packet format without Start, Shift Checksum and End identifier.

If data is not available N becomes 0.
Number of Bytes is: N

Up Load Result:

BLOCK 0 TI – 82H RECORD LENGTH = 07H
BLOCK 1 **NO DATA BYTES**
BLOCK 2

After successful event data transfer from data logger CMU will send this command.

TIME READ:

BLOCK 0 TI – 83H RECORD LENGTH = 07H
BLOCK 1 {No DATA BYTE is available}
BLOCK 2

Acknowledgement for TIME READ:

BLOCK 0 TI – C3H RECORD LENGTH = 0DH
BLOCK 1 (6 bytes) Byte 1-4 : Packed Time Byte 5: Year MSB (Hex) Byte 6: Year LSB (Hex)
BLOCK 2

TIME WRITE:

BLOCK 0 TI – 84H RECORD LENGTH = 0DH
BLOCK 1 (6 bytes) Byte1-4 : Packed Time Byte 5: Year MSB (HEX) Byte 6: Year LSB (HEX)
BLOCK 2

Acknowledgements for TIME WRITE:

BLOCK 0 TI – C4H RECORD LENGTH = 08H
BLOCK 1 (1 Byte) Byte 1: STATUS BYTE
BLOCK 2

STATUS BYTE: 00 Time Write Success
01 Time Write Fail

BUFFER FREE:

BLOCK 0 TI – 85H RECORD LENGTH = 07H
BLOCK 1 No Data
BLOCK2

This command will be sent between data loggers, to intimate other data logger that its buffer is free now and it can take event data.

ALL INPUT STATUS:

BLOCK 0 TI – 8BH RECORD LENGTH = 07H
BLOCK 1 {No DATA BYTE is available}
BLOCK2

Acknowledgement for ALL INPUT STATUS:

BLOCK 0 TI – CBH RECORD LENGTH = 07H
BLOCK 1 (1Byte) Byte1: Success 00
BLOCK2

This command will be sent whenever all digital input status need to be updated in CMU. This command will trigger all input event packets to be generated and the command will be acknowledged with above frame.

MODEM RESET:

BLOCK 0 TI – 8CH RECORD LENGTH = 08H
BLOCK 1 (1 Byte) Bit0-Modem in direction-A Bit1-Modem in direction-B
BLOCK2

If the bit is '1' Modem will be reset.

Acknowledgement for MODEM RESET:

BLOCK 0 TI – CCH RECORD LENGTH = 07H
BLOCK 1 (1Byte) Byte1: Success00
BLOCK2

BUFFER FULL:

BLOCK 0 TI – 8FH RECORD LENGTH = 07H
BLOCK 1 No Data
BLOCK2

This command will be sent between data loggers, to intimate other data logger that its buffer is full and it cannot take any more event data at present.

SET TRAN POINTER:

BLOCK 0 TI – 90H RECORD LENGTH = 10H
BLOCK 1 (9 bytes) Byte1: Port No (1...2) Bytes2 &3: SEQ No Byte4 to 7: Packed Time Byte8: DL ID Byte9: Search status.
BLOCK2

In bi directional ring communication, when there is a break in one direction, transmission of event packets in that direction gets stop. But in other direction the event packets continue to reach CMU. Once the broken communication link is restored, all pending event packets start flooding continuously towards the CMU. This increases network traffic. Also these packets have been already reached the CMU in other redundant communication path. In order to stop the flow of packets, the pointer in the data logger can be adjusted to the requested event packet. Thus stopping the old events packets flow. This command will move the pointer in the forward direction for the above said condition.

Likewise the pointer need to be moved in backward direction for the need of transmission of old event packets which are available in non-volatile memory. Thus by this command the pointer can be moved back and then old event packets starts transmitted.

Port No: 01H- Network Port in Direction-A
02H- Network Port in Direction-B

SEQ Number, Packed Time & DL ID are the parameters to match the event packet.

Search status : 00H- Forward search.
01H-Backward search.
02H-Set the Tran pointer to the beginning address of the event packets Database.

Acknowledgement for SET TRAN POINTER:

BLOCK 0 TI – D0H RECORD LENGTH = 11H
BLOCK 1 (8 bytes) Byte1:Status Byte2: Port No (1...2) Bytes3 &4: SEQ No Bytes5 to 8: Packed Time Byte9: DL ID Byte10: Search status.
BLOCK2

STATUS: 00-SUCCESS
01- SEARCHFAIL.
02- SEARCH FAIL DUE TO INVALIDPARAMETERS.
03- SEARCH FAIL DUE TO RECORDS DATA BASE IS INPURGING.

All Other parameters are echoed back.

GET RELAY STATUS(1-8):

BLOCK 0 TI – 91H RECORD LENGTH = 07H
BLOCK 1 { NO DATA BYTE }
BLOCK2

Acknowledgement for GET RELAY STATUS:

BLOCK 0 TI – D1H RECORD LENGTH = 08H
BLOCK 1 (1 Byte) Byte: Bits 0-7 represent the status of 1-8 relays respectively. If any bit is 1 then the respective relay is picked up and if any bit is 0 then that particular relay is in dropped condition.
BLOCK2

SET RELAY STATUS (1-8):

BLOCK 0 TI – 92H RECORD LENGTH = 08H

BLOCK 1 1. Bits 0-7 represent the status of 1-8 relays respectively. If any bit is 1 then that respective relay should be picked up and if any bit is 0 then that particular relay should be dropped.
BLOCK2

Acknowledgement for SET RELAY STATUS:

BLOCK 0 TI – D2H RECORD LENGTH = 07H
BLOCK 1 (1 Byte) Byte1: Status
BLOCK2

STATUS: 00-Success,
Non-Zero: Fail.

GET RELAY STATUS(9-16) :

BLOCK 0 TI – 93H RECORD LENGTH = 07H
BLOCK 1 { NO DATA BYTE }
BLOCK2

Acknowledgement for GET RELAY STATUS:

BLOCK 0 TI – D3H RECORD LENGTH = 08H
BLOCK 1 (1 Byte) Byte: Bits 0-7 represent the status of 9-16 relays respectively. If any bit is 1 then the respective relay is picked up and if any bit is 0 then that particular relay is in dropped condition.
BLOCK2

SET RELAY STATUS(9-16):

BLOCK 0 TI – 94H RECORD LENGTH = 08H
BLOCK 1 1. Bits 0-7 represent the status of 9-16 relays respectively. If any bit is 1 then that respective relay should be picked up and if any bit is 0 then that particular relay should be dropped.
BLOCK2

Acknowledgement for SET RELAY STATUS:

BLOCK 0 TI – D4H RECORD LENGTH = 07H
BLOCK 1 (1 Byte) Byte1: Status
BLOCK2

STATUS: 00-Success,

Non-Zero: Fail.

BLOCK1:

DATA:

Block 1 is for data, where length is variable.

BLOCK2:

CHECK SUM:

This checksum is 16-bit value, and it is placed in the Block2.

This is calculated as sum of all the bytes starting from RL MSB to last byte stored in BLOCK1.

Annexure-B1

Recommended digital & analogue inputs

Digital inputs

Relay contacts to be wired are given in the column **recommended digital inputs.** All relays required for tracing the operations and movements through simulation diagram and generation of fault alarms are recommended for monitoring.

Sn	Functions	Recommended digital inputs
1	Points	Switch /Button relays Lock Relay Operation Command Relay Detection Relay Emergency operation button relay Point stick relay Siding point control relay
2	Signal	Switch /Button Relay Control Relay Lamp Proving Relay
3	Track Circuit	Track Relay Track Stick Relay
4	Level crossing	Operations Command Switch/button relays Gate closed relay Gate locked relay Emergency gate release relay
5	Crank handle	Crank Handle key IN Relay Crank Handle Lock Relay Crank Handle Release Relay Crank handle button relay
6	Axle counter	Axle Counter Proving Relay Axle Counter Preparatory Reset Relay Axle Counter Reset Cooperation Relay
7	Route	Route Button Relay Route Freeness Checking Relay (ASR) Route Checking Relay Route Locking Relay Route Release Relay Route Cancellation Button Relay Route Cancellation Initiation Relay Route Cancellation Timer Relay Overlap Locking Relay Overlap Cancellation Relay

		Direction relays
8	Route sections	Locked / free
9	Push buttons	Pressed/released
10	SM's key	In/Out
11	Insulation of Sig. Cable	Good /bad (through ELDs)
12	Slots (Outgoing)	Given/not given Locked/ released
13	Slots (Incoming)	Received /Absent
14	Switch (2position)	Normal/ Reverse
15	General Relay	Pickup / drop
16	Block Operations Relays	**SGE Block** LCPR, SR, ZR, LSSDR **PTJ – Token-less block** ASCR, TAR, All internal relays which have spare contact **FM- Daido Type** HSR, ASDR, **Neal's Token block** TGTR, LSSDR **UFSBI** All Interface & Interlocking relays **SSBPAC** All Interface relays & Block panel inputs
17	MISC Relays	Time element relays Power monitoring relay Point, signal failure relay SMR Siding control relay Siding switch/button relay Slot switch/button relay Slot control relay King lever/switch relay Relay room open/closed ELD(Earth Leakage Detection) contacts Approach track relays Auto change over

18	IPS	INVERTER 1 FAIL INVERTER 2 FAIL FRBC output fail DC-DC converter fail MAINS fail Call S&T Staff Battery low (50% deep discharge)
19	IBH	Control Relays Pass at ON Relays Stick Relays Reset Relays
20	Electronic Interlocking	All interface relays
21	Fire Alarm	Fire Alarm ON /OFF
22	Surge Protection device	Healthy / Fail

List of Analog inputs

xvi. Where IPS is provided.

1. 230 V AC -- All the **primary power supplies** given as input to IPS - (Ex. UP AT supply, DN AT supply, Local supply, standby generator-1, standby generator-2, Selected suppl of the above to feed the IPS)
2. 110V DC supply (output of SMPS charger and battery bank in parallel)
3. 110V DC for EI
4. 110V AC supply to UP track circuits
5. 110V AC supply to DOWN track circuits
6. 110V AC supply for UP signals lighting
7. 110V AC supply for DOWN signals lighting
8. 110V AC Location lighting

DC -to- DC converters output voltages:

1. Internal
2. External-1
3. External-2
4. Block local supply-1
5. Block local supply -2
6. Block line supply-1
7. Block line supply-2
8. Data Logger

9. Axle Counter
10. EKT
11. Spare Cells
12. EI
13. Panel indication

xvii. Where IPS is not provided:

1. 230V AC - UP AT supply, DN AT supply, Local supply, standby generator-1, standby generator-2, Selected supply of the above)
2. 110VDC Point – UP
3. 110VDC Point – DN
4. 110V AC supply to track circuits
5. 110V AC supply for UP signals lighting
6. 110V AC supply for DOWN signals lighting

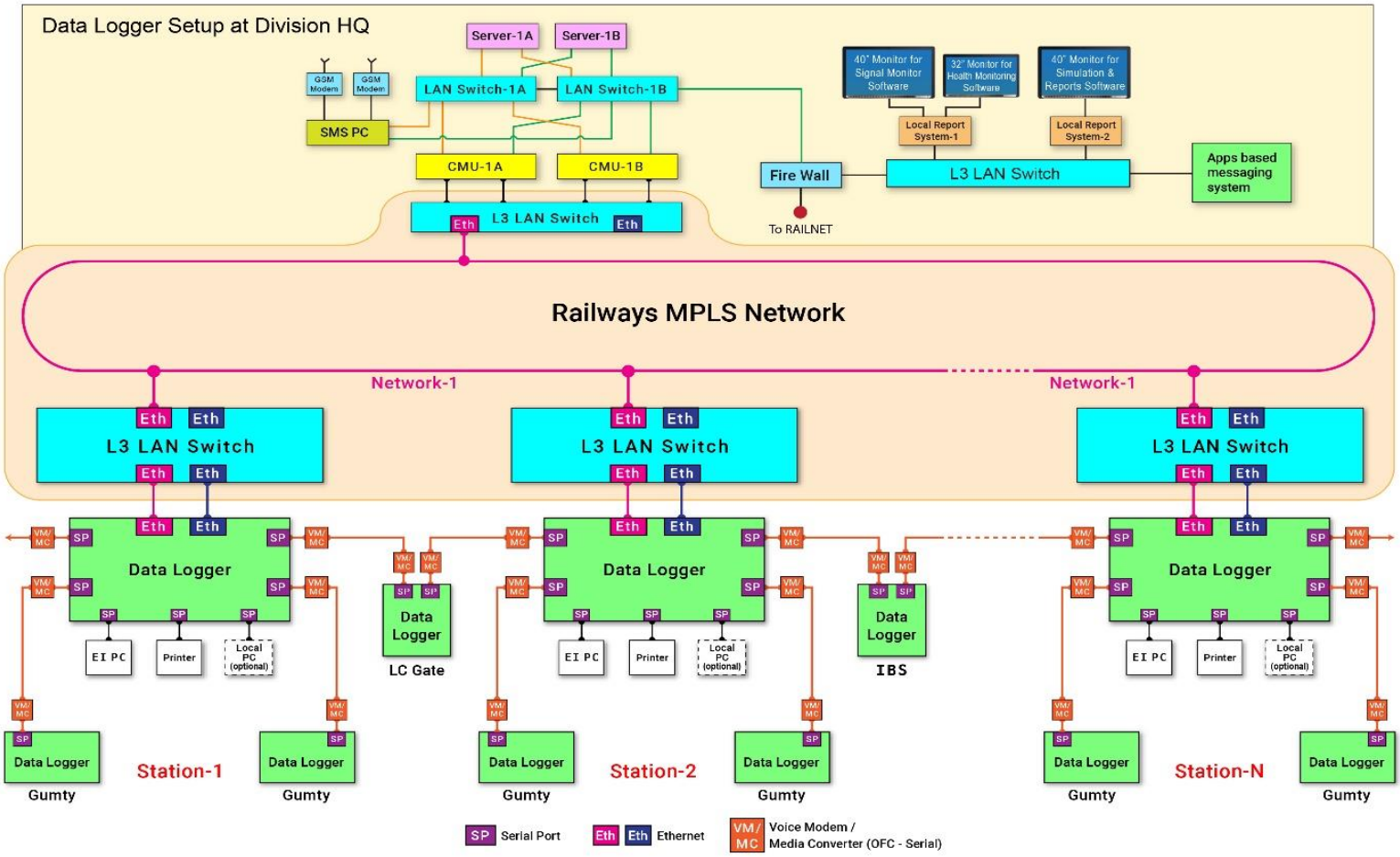
DC power supplies

1. Internal
2. External – 1
3. External – 2
4. Axle Counter
5. Data Logger
6. Block local – 1
7. Block local – 2
8. Block line – 1
9. Block line – 2
10. EKT'
11. EI
12. Panel Indication

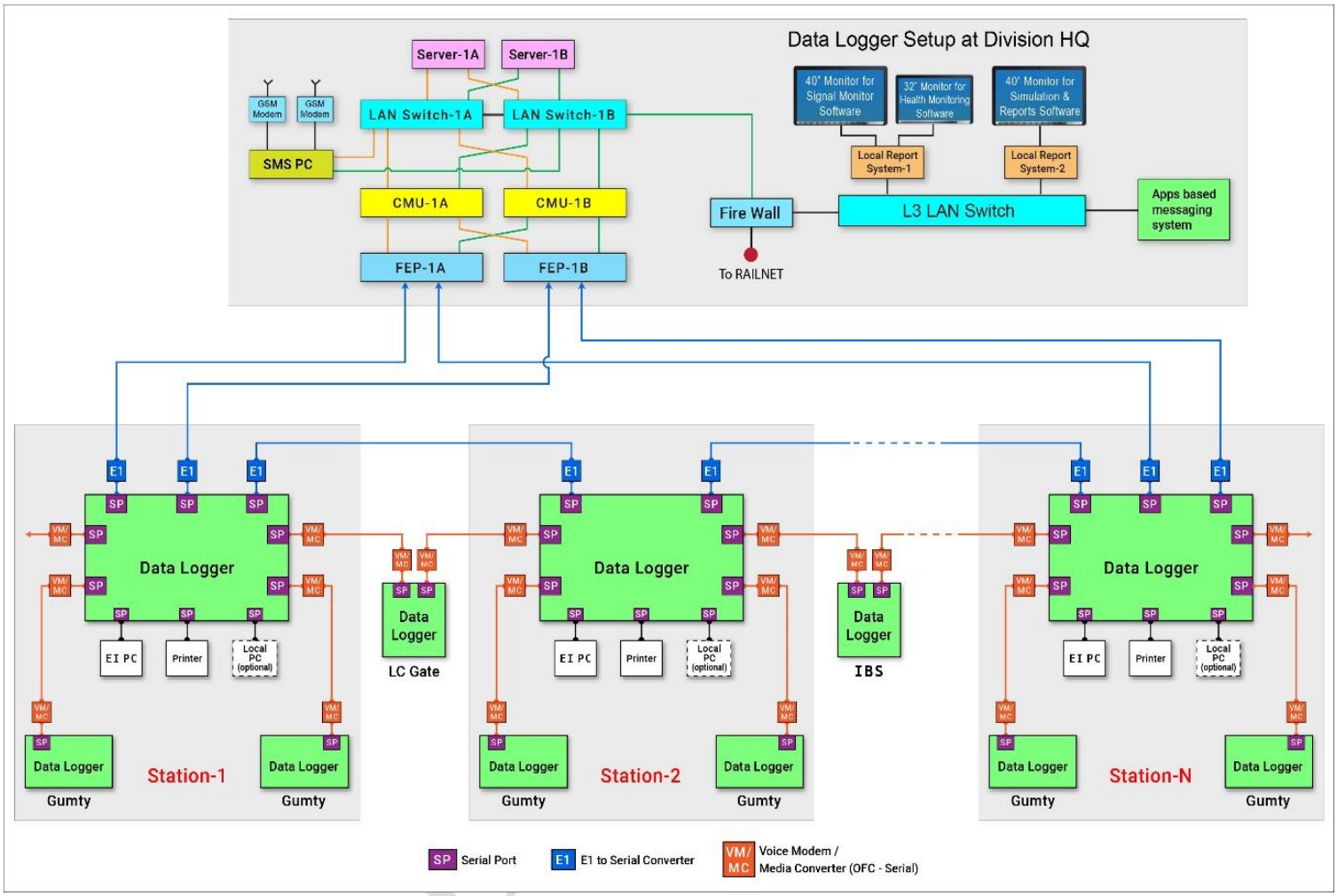
Note: The purchaser shall indicate any additional field information required to be recorded.

Annexure-B2

A. Schematic architecture of networking of Ethernet compatible Data logger:

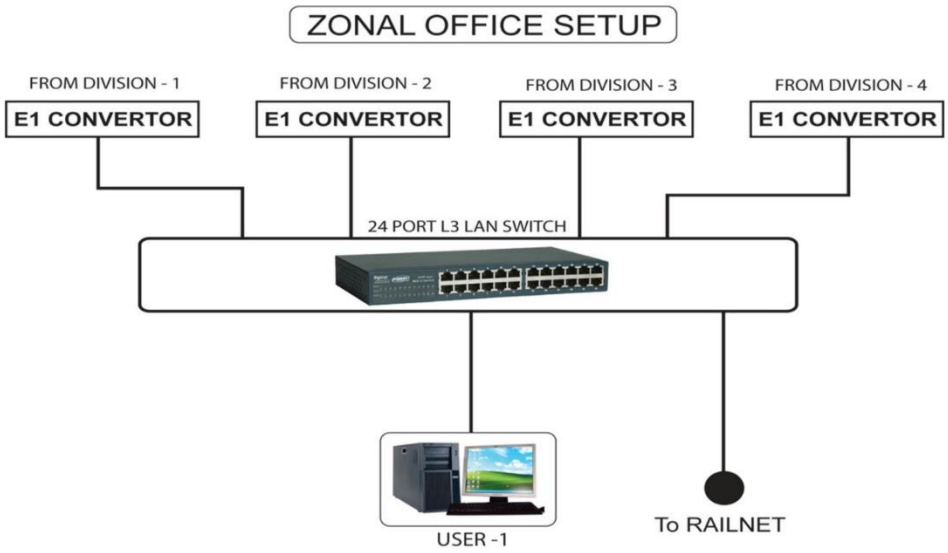


B. Schematic architecture of networking of Data logger with E1 channels:



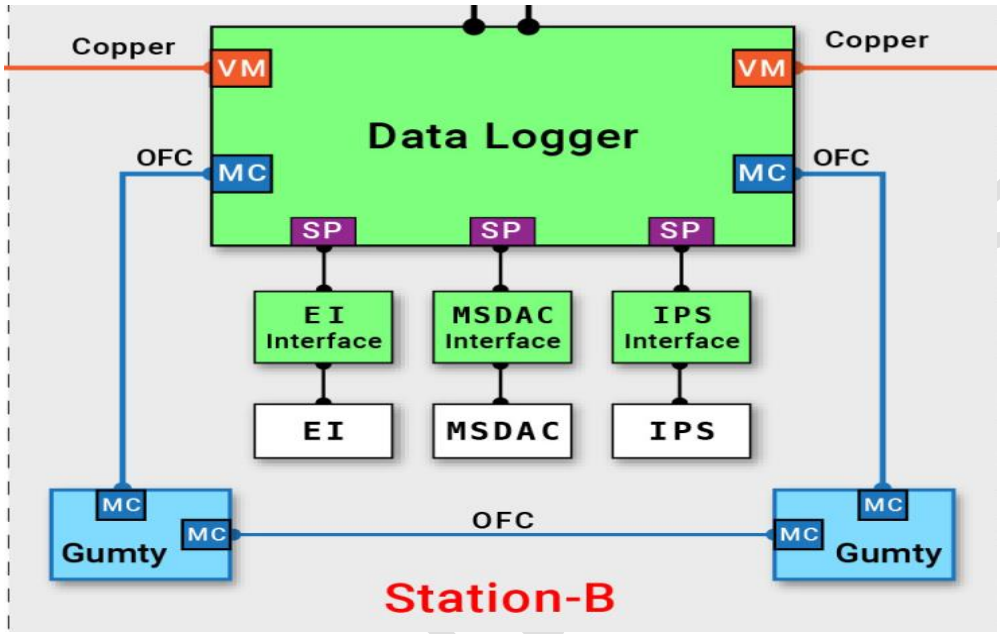
Annexure-B3

Schematic Architecture of Zonal Office Setup:



Annexure-B4

Diagnostic data of EI, MSDAC, IPS to data logger



Station data logger receives diagnostic data from processor based equipment like EI, MSDAC & IPS

Annexure-B5

Ethernet modules shall comply following parameters:

Ethernet Parameters	
Number of Ports	2 Number of 100Base -TX
Standard	IEEE 802.3 compatible
connector	Standard Ethernet Connector
Serial Communication Port Parameters:	
Interface Types	Serial
Baud Rate	up to 115200.
Power Supply Parameters:	
Input Voltage Working Range	18 to 32V DC.
Power Consumption	5Watt (Max.)
Thermal Characteristics:	
Operating Temperature	-10˚C to +70˚C

Annexure-B6

Hardware specifications CMU, SERVER, FIREWALL, LAN Switch
Following are the minimum required specification; it is always acceptable to provide IT equipment with better features than the listed specification.

1	PC Type	Industrial Grade
2	Processor	Intel® Core™ i7-11700 Processor 16M Cache, up to 4.90 GHz
3	RAM	16 GB Memory or as required for latest OS and application software
4	HDD	256*2 SSD
5	Ethernet	Dual Gigabit Ethernet ports
6	Serial ports	2 serial ports
7	I/O Devices	Keyboard (USB)
8		Mouse (USB optical)
9	Operating System	Windows 10 Professional OS
10	Antivirus	Kaspersky, Quick heal, McAfee or any reputed brand.
11	Monitor	22” LED Monitor-1 No
12	Make	Make: HP/IBM/DELL or any reputed brand.

Server:

1	Processor	Intel(R) Xeon(R) X5650 2.66GHz, 12M cache
2	RAM	32GB Memory (8x4GB) or as required for latest OS and application software
3	HDD	3 * 900GB SSD
4		RAID Controller 2GB Cache
5	Ethernet port	Dual-port Gigabit Ethernet
6	Power supply	Redundant power supply
7	DVD Writer	DVD Writer, SATA
8	I/O Devices	Keyboard (USB)
9		Mouse (USB optical)
10	Operating System	Windows 2019 server standard edition 64 bit
11	Antivirus	Kaspersky, Quick heal, McAfee or any reputed brand.
12	Monitor	22” LED Monitor
13	Make	Make: HP/IBM/DELL or any reputed brand.

Firewall:

1	Make	Make: Sophos XG 106 25ia or Similar
2	Ethernet Port Speed	10/100/1000GBEPort
3	Type of Zones	Configurable Internal/DMZ/WAN Port
4	Console	Console Port (RJ45/DB9)
5	Power Supply	External auto ranging DC: 12V, 100-240VAC, 24W@50-60 Hz

LAN SWITCH:

L3-LAN SWITCH:

1	Ethernet Ports	Combo SFP Slots
2		Open Slot for 10-Gigabit Uplink Modules
3	Console	RS-232 Console Port
4	Routing	L3 Routing
5		Floating Static Route
6		Policy Based Route
7	VLAN's	Multiple IP Interfaces per VLAN (Up to 5)
8	Power supply	Nominal 230V AC
9	Ports	Minimum 24

L2-LAN Switch:

1	Ethernet Ports	4 port Connector: RJ-45 10/100/1000 Base-T
2	Power Supply	Nominal 230V AC
3	Ports	Minimum 24

UPS:

i. 1KVA ONLINE UPS for 30min backup for each Server separately Make: APC/Vertiv/Numeric
ii. 3KVA ONLINE UPS for 3hours backup for two Server, LAN Switches, Fire wall Make: APC/Vertiv/Numeric
iii. 5KVA ONLINE UPS for 3hours backup for four Server, LAN Switches, Fire wall Make: APC/Vertiv/Numeric
iv. 1KVA OFF-LINE UPS for 30min backup for each PC separately Make: APC/Vertiv/Numeric
v. 1KVA ONLINE UPS for 30min backup for each CMU separately Make: APC/Vertiv/Numeric

Annexure-B7

List of Alarms to be generated by CMU

Alert / Alarm report consists of events detected by the change of status of relays to satisfy a combinational and sequential logic. These reports are also called exception reports. They are categorized into 3 parts based on usage.

1. Maintenance 2. Safety and 3. Operations

Since logic is satisfied for many momentary incidences at present hundreds of events(alarms) are created and they POP Up on the VDU screen of PC provided in the test room (ex. 1. Material trolley kept on track when there is no train 2. Signal, point or track circuit bobbing when no train is affected).

Similarly, many wrong alarms are created when a digital input status is not monitored by data logger (because of high contact resistance, wiring problem). They also create lot of wrong alarms.

This is making it difficult for the user to search for a failure which affected train movement. Keeping this in view failures are categorized as momentary and confirmed. Confirmed failures are those which continue for more than 2 minutes. However certain momentary failures like signal flew back to danger are classified as confirmed failures. Unimportant alarms like late start of train, late clearance of train is categorized as momentary. While all failures are recorded only confirmed failures are enabled in POP Up screen. User can have access to momentary failures also.

Events covered under each category and their classification of momentary and confirmed are given below

Maintenance related reports			
S.NO	**FAULT NAME**	**momentary**	**confirmed**
1	signal bobbing	M	
2	track bobbing	M	
3	point bobbing	M	
4	point failure	M	C 120 Sec
5	sluggish operation of point	M	
6	track circuit failure	M	C 120 Sec
7	fusing of signal lamp	M	C 120 Sec

8	signal blanking	M	C 120 Sec
9	signal flying back to danger	M	C 120 Sec
10	timer setting more	M	
11	button stuck up		C
12	point loose packing		C
13	signal bobbing without design problem (i.e. signal control relay not dropped)	M	
14	signal bobbing with design problem (i.e. signal controlrelay dropped)	M	
15	signal not lowered even operation is valid		C
16	power supply failure alarm	M	C 120 Sec
17	Fuse blown off (additional hardware to be used to detect fuse failure)		C
18	ELD detected low insulation of supply ---- (Potential free contact of ELD to be wired as input todata logger)		C
19	Route not set when operation is valid giving the sequence of relay operations. (1. Possible in case of panels where button/switch relays pick up with operation of button/switch even-though the operating conditions are not favorable. 2. Sequence of relays shall be provided by railways 3. Not possible for switch operated non-route setting type panel)		C
20	Dual detection DAC Failure		C
21	Emergency Point Operation		C
22	TFR Relay Stuckup	MM	

Safety related reports			
S.NO	**FAULT NAME**	**momentary**	**Confirmed**
1	Point burst	M	C 120 Sec
2	Clearing of signal without route locking	M	C
3	Timer setting less	M	C
4	Check for passing of danger signal		C
5	Route released without sequential –routerelays in route picking up		C
6	Signal assuming green with points in the route reverse		C
7	Home/main line-starter signal assuming green with adv-starter danger		C
8	Advance starter off without line clear		C
9	Over speeding	M	
10	Failure to set point against occupied line		C
11	Relay room opening		C
12	Emergency route cancellation		C
13	Point emergency operation when point controlling track(s) fails		C
14	Axle counter resetting		C
15	Train passing blank signal		C
16	Crank handle transferred when route locked		C
17	Gate open without transfer of control		C
18	Gate signal OFF with gate open		C
19	Point status is changed without operation		C
20	Signal not gone to danger after first control track dropped		C
21	SPAD at Adv Str without Shunt Permission	SC	
22	Wrong Operation	MM	

Operation related reports			
S.NO	**FAULT NAME**	**momentary**	**confirmed**
1	late start of train	M	
2	Late lowering of home signal	M	
3	Premature operation of double line block to TOL		C
4	Late Closure of LC Gate	M	
5	Emergency Sub Route Released	OM	
6	Emergency Overlap Cancellation	OM	
7	Emergency Signal Cancellation	OM	
8	Point Repeated Operation	OM	
9	Panel Failure due to AC Power Failure	MM	
10	Panel Failure due to DC Power Failure	MM	
11	Shunting with Permission	MM	
12	IPS Failure	MC	
13	IPS Restored	MM	

14	Route not Released	MM	
15	Calling On Operation	MM	
16	Emergency Route Released	OM	

Note: For fault logics, please refer the latest version of Annexure-11 A1 of IRSEM.

Annexure-B8

C. Optical Fiber Transceiver Parameters:

Medium type	single mode fiber
Fiber Termination connectors	SC connector
Medium Wavelength	1310nm ±40nm
Data rate	up to 2Mbps
Transmission Distance	20Km {Max) is under standard test conditions.
Serial Communication Port Parameters:	
Interface Types	Serial
Baud Rate	up to 115200.
Power Supply Parameters:	
Input Voltage Working Range	External Media Converter: 18 to 32V DC. Inbuilt Media Converter: 5 V DC.
Power Consumption	1Watt (Max.)
Thermal Characteristics:	
Operating Temperature	-10 ˚C to +70˚C

D. Modem Parameters

Line Rate	14400 bps
Standard	ITU V.32
Operation	4-wire / 2- wire full-duplex leased line
Line Impedance	600 ohms
Line Isolation	1000Vrms
Serial Communication Port Parameters:	
Interface Types	Serial
Baud Rate	up to 115200.
Diagnostics	Loop back test
Power Supply Parameters:	

Input Voltage Working Range	External Modem: 18 to 32V DC. Inbuilt Modem: 5 V DC.
Power Consumption	5Watt (Max.)
Thermal Characteristics:	
Operating Temperature	-10 ˚C to +70˚C

E. Modem Parameters:

Line Rate	2.048 Mbps
Standard	E1 interface as per G.703
Operation	4-wire full-duplex
Line Impedance	120 ohms (Balanced)
Connector	RJ45 for balanced
Serial Communication Port Parameters:	
Interface Types	Serial
Baud Rate	up to 115200.
Power Supply Parameters:	
Input Voltage Working Range	External converter: 18 to 32V DC. Inbuilt converter: 5 V DC.
Power Consumption	5Watt (Max.)
Thermal Characteristics:	
Operating Temperature	-10 ˚C to +70˚C

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Annexure-B9

Architecture of both SMS based alarms and provision for APP basedalarms / notification system: