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Issue	3
Date	April 2005

Requirement Specification for TDM Systems (formerly RT/E/PS/00801)

This temporary front sheet facilitates change to the new Network Rail Standards referencing nomenclature.

The Ref above will be formally allocated to this standard when it is next changed in the meantime the contents, date and issue number of this Network Rail Standard are UNCHANGED and with immediate effect it should be referred to as “(new ref) formerly (old ref)”.

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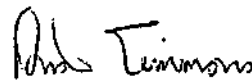
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Company Product Specification

Requirement Specification for TDM Systems

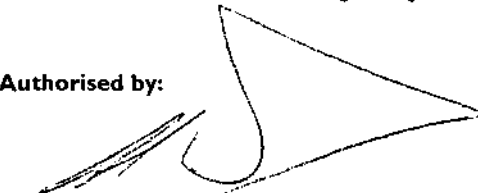
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Endorsed by:



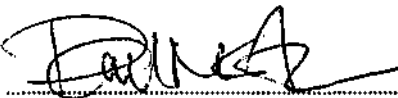
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Issue record

Issue	Date	Comments
1	December 2001	First Issue supersedes BR801 and ST1171A (Section 2)
2	February 2004	Addition of appendix describing use of TDM systems for safety applications and using open transmission.
3	April 2005	Redefinition of Signal Replacement controls.

Implementation

The requirements specified in this document shall be enforced from 2nd April 2005.

Compliance

Suppliers of new equipment purchased on or after 1st July 2005 shall comply with this Product Specification unless express written permission is obtained for any deviation from Network Rail.

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I Purpose

I.1 Aim

I.1.1

The aim of this specification is to define the requirements for a basic bit to bit Time Division Multiplex (TDM) transmission system suitable for use in a variety of signalling applications on Network Rail.

I.1.2

Bit to bit describes a one to one relationship between the input at one end and the output at the other. This may include multi-drop applications. It specifically excludes any bit manipulation such as panel processing or button processing.

I.1.3

Multi-drop applications are only applicable to dedicated networks where the link can be considered point-to-point.

I.1.4

The requirements address the needs of modern signalling schemes, whether for new works or as part of a renewal, and thus reduce the level of prescriptive detail in tenders regarding the TDM system.

I.2 Background

I.2.1

TDM, in its most basic form, is a method of transmitting several electrical signals down the same circuit or channel by allocating regular time slots for each signal. This provides the benefit of not requiring several dedicated circuits or channels which could be expensive when transmitting data over long distances.

I.2.2

For the purposes of this specification, a TDM system is defined as any system on Network Rail that uses Time Division Multiplex techniques to transmit controls or indications (which are either in the 'on' or 'off' state) down a variety of voice frequency (VF), digital or fibre-optic media.

I.2.3

The Purchaser is expected to specify what type of transmission media the TDM system must comply with.

2 Scope

2.1 General

2.1.1

The requirements contained in this specification apply both to new TDM systems and retrofit replacements. However extensions or part replacements may not be required to meet every requirement within this specification if it can be demonstrated that this is necessary to achieve compatibility with existing connected equipment.

2.1.2

The TDM system described in this specification is considered suitable for signalling applications where the transmission of data must be achieved to a safety integrity level (SIL) equivalent to 1. Example applications include:

- Remote interlockings
- CCTV level crossing control
- Emergency alarms between signalling control centres
- Condition monitoring
- Ground Frame releases where signal proving is local to the Ground Frame

2.1.3

The above applications govern the interface requirements of the TDM system (see Section 5.2) and also the performance requirements demanded by the different signalling applications (see Section 4).

2.2 Constraints

2.2.1

The TDM system described in the body of this specification is not considered suitable for any of the following safety critical functions without additional controls:

- 'All Signals On' Replacement
- CCTV Crossing Clear
- Automatic Signal Replacement using 'R' buttons
- Emergency Block Bells
- Tokenless Block

- Ground Frame releases with signal on proving or safety functions included
- Direct control of points, signals and other safety critical trackside functions

Additional requirements for these functions are attached as appendix A.

2.2.2

The TDM system, as described in this specification, is not considered suitable for panel processing, button processing or equivalent functions.

2.2.3

Should this specification be re-issued to include any special applications on particular Network Rail Territories, then these additional requirements will be attached as separate appendices.

3 Definitions

All terms and abbreviations used in this specification are defined below: -

BABT	British Approvals Board for Telecommunications
BCH	Bose Chaudhuri Hocquenheim
BR	British Railways
CCTV	Closed-circuit Television
CD-ROM	Compact Disk Read Only Memory
CENELEC	The European Committee for Electrotechnical Standardisation
COSHH	Control of Substances Hazardous to Health
CRC	Cyclic Redundancy Code
EMC	Electromagnetic Compatibility
EMF	Electromotive Force
I/O	Input/Output
IECC	Integrated Electronic Control Centre
ITU	International Telecommunications Union
LED	Light Emitting Diode

MTBF	Mean Time Between Failures
MTTR	Mean Time To Repair (excluding travelling time)
PTO	Public Telephone Operator
RAM	Reliability, Availability and Maintainability
'R' Button	Auto-signal replacement control that proves signal on and alight and disengaged on site.
RTTE	Radio and Telecommunications Terminal Equipment
SIL	Safety Integrity Level
SMS	Signalling Maintenance Specification
TDM	Time Division Multiplex
VF	Voice Frequency

4 Performance Requirements

4.1 Basic Requirements

4.1.1 The basic requirements of the TDM system shall be to:

- provide a dependable means of transmission between the signalling control centre and:
 - remote interlockings;
 - CCTV level crossings;
 - signalling control centres controlling adjacent signalling areas;
 - track-side signalling equipment (non-vital indications only);
- be able to be retrofitted with the minimum of alterations/interference to the interfaces to the existing circuitry;
- have a flexible capacity;
- facilitate safe and efficient commissioning;
- be configured such that any failures of the TDM system can be quickly diagnosed;
- be easily maintainable.

4.1.2

The performance requirements contained in the following sub-sections shall be achieved with respect to the scope of applications defined in Section 2.

4.2 Reliability

4.2.1

For single failures capable of causing the total loss of the TDM system, a mean time between failures (MTBF) of at least:

- a. 8,760 operating hours shall be achieved for single system with a 512 bit capacity;
- b. 50,000 operating hours shall be achieved for dual redundant or duplicated systems with a 512 bit capacity.

4.2.2

For systems with higher bit capacities the total loss failure rates shall be consistent with the MTBF requirements specified above. The Purchaser shall specify any application specific reliability targets.

4.2.3

The MTBF for any single or group of transmission bits (the TDM system inputs and outputs shall be grouped together in logical quantities, e.g. 8, 16, 32 etc.) within a 512 bit capacity system shall exceed:

- a. 4,000 operating hours for a single system;
- b. 20,000 operating hours for a dual redundant or duplicated system.

4.2.4

The failure of a single bit or group of transmission bits shall not cause the failure of the whole system.

4.3 Maintainability

4.3.1

Single failures causing the overall or partial loss of the TDM system shall be diagnosed and repairable under the 1st line maintenance regime with an MTTR of 30 minutes.

4.3.2

In the event of an overall transmission system failure that is not due to fault in the TDM system, the TDM diagnostic function shall be able to identify, where practicable, the failed attached system.

4.3.3

Based on the particular operational requirements at individual sites, the Purchaser may specify requirements for remote diagnostics at a maintenance centre.

4.3.4

Where practicable, line replaceable units shall be hot changeable without impairing the continued functionality of the system, i.e. the TDM system shall appear to operate normally, or with minimal loss of capability, when failed line replaceable units are being changed.

4.4 Availability

4.4.1

Excluding the communications links but including power supplies, the steady state availability of the overall TDM system shall not be less than:

- a. 99.98% for a single 512 bit system;
- b. 99.997% for a dual redundant or duplicated 512 bit system.

The above figures are based on the reliability and maintainability targets specified in Sections 4.2.1 & 4.3.1 respectively, and assuming a 1 hr access time.

4.4.2

Where the TDM system is dual redundant or duplicated, automatic and manual changeover operation shall be provided where changeover occurs without loss of functionality.

4.5 Safety

4.5.1

The Supplier shall demonstrate that the system design and performance is at least equivalent to safety integrity level (SIL) 1 for hazardous failures according to CENELEC guidelines [2 & 16].

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4.5.2

Higher levels of safety integrity shall be demonstrated by the Supplier if required for the specific application. For example, use of multi-bit encoding. [Additional guidance is given in Appendix A.5.1.]

4.5.3

The system may be used over open or closed transmission systems as defined in BS EN 50159 parts 1 & 2 respectively [20 & 21].

4.5.4

The system design shall ensure that adequate defences are provided against all identified threats to the safety of the system by following the general requirements of EN50159-2 [21]. [Additional guidance is given in Appendix A.5.2 for closed and open transmission links up to Class 5]

4.5.5

The system shall demonstrate a high level of immunity to common-mode-type failures.

4.5.6

At system power up all outputs shall be in the 'off' state until the transmission of data bits can be established.

4.6 Alarms

4.6.1

Upon complete or partial system failure, a Signaller's alarm shall be raised and the outputs associated with the channels shall enter the following pre-defined state:

- a. Complete Failure: all outputs to be in the 'off' state.
- b. Partial Failure: the state of all outputs shall be agreed with the Purchaser and configured prior to installation. Options that shall be made available to the Purchaser are for: