

# INTERNATIONAL STANDARD

# IEC 60870-5-104

Second edition  
2006-06

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**Telecontrol equipment and systems –**

**Part 5-104:  
Transmission protocols –  
Network access for IEC 60870-5-101  
using standard transport profiles**

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Reference number  
IEC 60870-5-104:2006(E)

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## INTERNATIONAL ELECTROTECHNICAL COMMISSION

## TELECONTROL EQUIPMENT AND SYSTEMS –

**Part 5-104: Transmission protocols –  
Network access for IEC 60870-5-101 using  
standard transport profiles**

## FOREWORD

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International Standard IEC 60870-5-104 Ed.2 has been prepared by IEC technical committee 57: Power systems management and associated information exchange.

This second edition cancels and replaces the first edition published in 2000 and constitutes a technical revision. The main changes of this second edition with respect to the previous edition are as follows: improvement of the sequences and interoperability of the protocol and addition of new functions for the handling of redundant connections.

The text of this standard is based on the following documents:

FDIS	Report on voting
57/812/FDIS	57/819/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC directives, Part 2.

IEC 60870-5 consists of the following parts, under the general title *Telecontrol equipment and systems – Part 5: Transmission protocols*

- Part 5: Transmission protocols – Section One: Transmission frame formats
- Part 5: Transmission protocols – Section 2: Link transmission procedures
- Part 5: Transmission protocols – Section 3: General structure of application data
- Part 5: Transmission protocols – Section 4: Definition and coding of application information elements
- Part 5: Transmission protocols – Section 5: Basic application functions
- Part 5-6: Guidelines for conformance testing for the IEC 60870-5 companion standards
- Part 5-101: Transmission protocols – Companion standard for basic telecontrol tasks
- Part 5: Transmission protocols – Section 102: Companion standard for the transmission of integrated totals in electric power systems
- Part 5-103: Transmission protocols – Companion standard for the informative interface of protection equipment
- Part 5-104: Transmission protocols – Network access for IEC 60870-5-101 using standard transport profiles
- Part 5-601: Conformance test cases for the IEC 60870-5-101 companion standard

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- amended.



## INTRODUCTION

IEC 60870-5-101 provides a communication profile for sending basic telecontrol messages between a central telecontrol station and telecontrol outstations, which uses permanent directly connected data circuits between the central station and individual outstations.

In some applications, it may be required to send the same types of application messages between telecontrol stations using a data network containing relay stations which store and forward the messages and provide only a virtual circuit between the telecontrol stations. This type of network delays messages by varying amounts of time depending on the network traffic load.

In general, the variable message delay times mean that it is not possible to use the link layer as defined in IEC 60870-5-101 between telecontrol stations. However, in some cases it is possible to connect telecontrol stations having all three layers of the companion standard IEC 60870-5-101 to suitable data networks using Packet Assembler Disassembler (PAD) type stations to provide access for balanced communication.

In all other cases this companion standard, which does not use the link functions of IEC 60870-5-101, may be used to provide balanced access via a suitable transport profile.

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## TELECONTROL EQUIPMENT AND SYSTEMS –

### Part 5-104: Transmission protocols – Network access for IEC 60870-5-101 using standard transport profiles

#### 1 Scope and object

This part of IEC 60870 applies to telecontrol equipment and systems with coded bit serial data transmission for monitoring and controlling geographically widespread processes. It defines a telecontrol companion standard that enables interoperability among compatible telecontrol equipment. The defined telecontrol companion standard utilizes standards of the IEC 60870-5 series. The specifications of this part present a combination of the application layer of IEC 60870-5-101 and the transport functions provided by a TCP/IP (Transmission Control Protocol/Internet Protocol). Within TCP/IP, various network types can be utilized, including X.25, FR (Frame Relay), ATM (Asynchronous Transfer Mode) and ISDN (Integrated Service Data Network). Using the same definitions, alternative ASDUs (Application Service Data Unit) as specified in other IEC 60870-5 companion standards (for example, IEC 60870-5-102) may be combined with TCP/IP, but this is not described further in this part.

NOTE Security mechanisms are outside the scope of this standard.

#### 2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60870-5-3:1992, *Telecontrol equipment and systems – Part 5: Transmission protocols – Section 3: General structure of application data* –104:2006

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IEC 60870-5-4:1993, *Telecontrol equipment and systems – Part 5: Transmission protocols – Section 4: Definition and coding of application information elements*

IEC 60870-5-5:1995, *Telecontrol equipment and systems – Part 5: Transmission protocols – Section 5: Basic application functions*

IEC 60870-5-101:2003, *Telecontrol equipment and systems – Part 5-101: Transmission protocols – Companion standard for basic telecontrol tasks*

IEC 60870-5-102:1996, *Telecontrol equipment and systems – Part 5: Transmission protocols – Section 102: Companion standard for the transmission of integrated totals in electric power systems*

ITU-T Recommendation X.25:1996, *Interface between Data Terminal Equipment (DTE) and Data Circuit-terminating Equipment (DCE) for terminals operating in the packet mode and connected to public data networks by dedicated circuit*

IEEE 802.3:1998, *Information technology – Telecommunications and information exchange between systems – Local and metropolitan area networks – Specific requirements – Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications*

RFC 791, *Internet Protocol, Request for Comments 791 (MILSTD 1777) (September, 1981)*

RFC 793, *Transmission Control Protocol, Request for Comments 793 (MILSTD 1778) (September, 1981)*

RFC 894, *Internet Protocol on Ethernet Networks*

RFC 1661, *Point-to-Point Protocol (PPP)*

RFC 1662, *PPP in HDLC Framing*

RFC 1700, *Assigned Numbers, Request for Comments 1700 (STD 2) (October, 1994)*

RFC 2200, *Internet Official Protocol Standards, Request for Comments 2200 (June, 1997)*

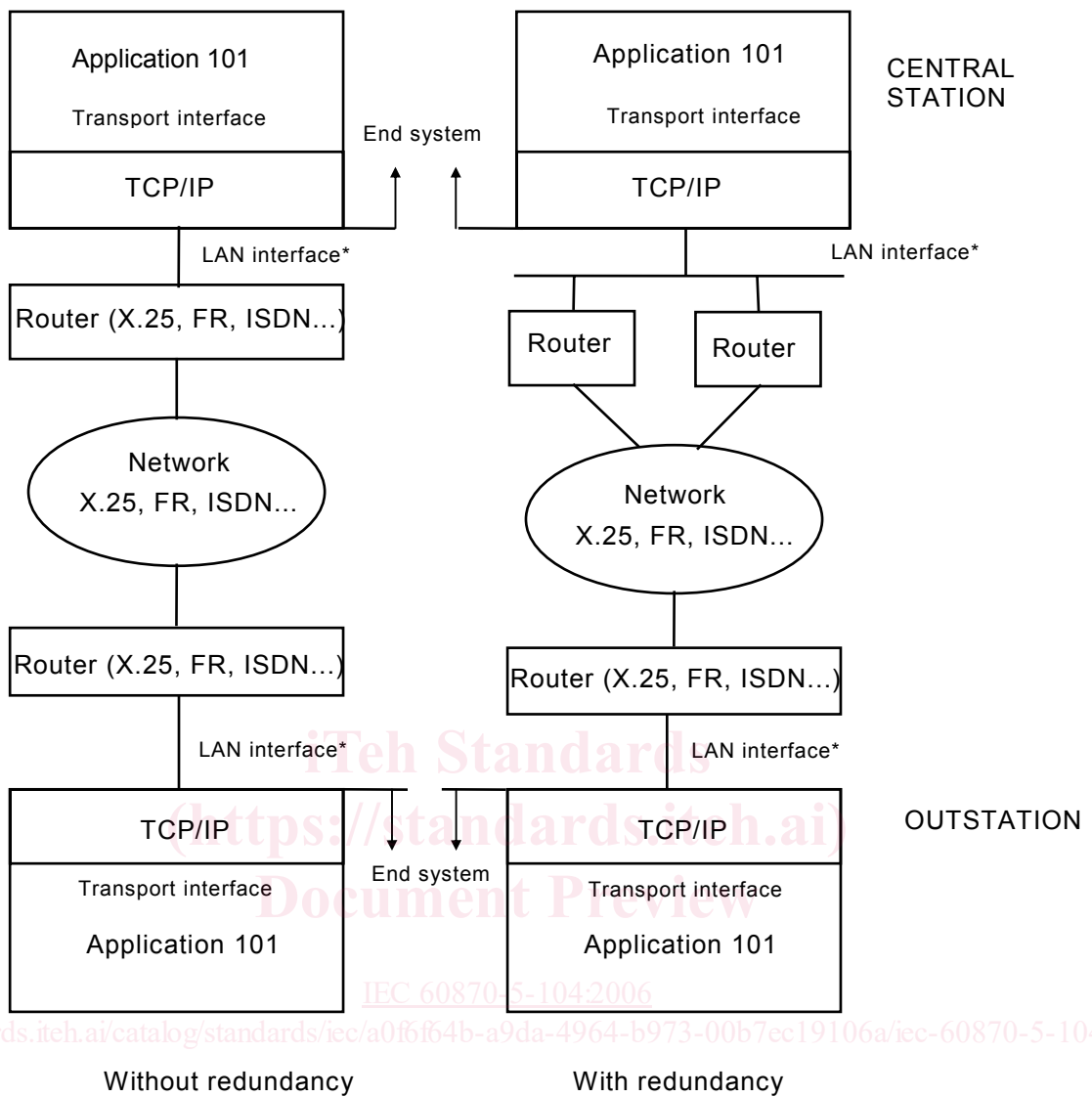
### 3 General architecture

This standard defines the use of an open TCP/IP-interface to a network, containing for example a LAN for telecontrol equipment, which transports IEC 60870-5-101 ASDUs. Routers which include the different WAN-types (for example, X.25, Frame Relay, ISDN, etc.) may be connected via a common TCP/IP-LAN-interface (see figure 1). Figure 1 shows a redundant configuration in the central station in addition to a non-redundant system.

Motivations:

The use of separate routers offers the following advantages.

- There is no need for network-specific software in end systems.
- There is no need for routing functionality in end systems.
- There is no need for network management in end systems.
- It facilitates obtaining end systems from manufacturers that specialize in telecontrol equipment.
- It facilitates obtaining individual separate routers, to suit a variety of networks from manufacturers specializing in this non-telecontrol specific field.
- It is possible to change the network type by replacing only the router type, without affecting the end systems.
- It is particularly suitable for converting existing end systems that conform to IEC 60870-5-101.
- It is suitable for present and future implementations.



\* The LAN interface may be redundant.

Figure 1 – General architecture (example)

#### 4 Protocol structure

Figure 2 shows the protocol structure of the end system.

Selection of application functions of IEC 60870-5-5 according to IEC 60870-5-101	Initialization	<b>User process</b>
Selection of ASDUs from IEC 60870-5-101 and IEC 60870-5-104		<b>Application (layer 7)</b>
APCI (Application Protocol Control Information) <b>Transport Interface (user to TCP interface)</b>		
Selection of TCP/IP protocol suite (RFC 2200)		<b>Transport (layer 4)</b>
		<b>Network (layer 3)</b>
		<b>Link (layer 2)</b>
		<b>Physical (layer 1)</b>
NOTE Layers 5 and 6 are not used.		

IEC 2786/2000

**Figure 2 – Selected standard provisions of the defined telecontrol companion standard**

Figure 3 shows the recommended selection of the TCP/IP Protocol suite (RFC 2200) used in this standard. At the time of publication, the RFCs indicated were valid, but may have been replaced in the meantime by equivalent, relevant RFCs. The relevant RFCs are available at the Internet address <http://www.ietf.org>.

The Ethernet 802.3 stack shown may be used by a telecontrol station end system or DTE (Data Terminal Equipment) to drive a separate router as shown in the example in figure 1. If a redundant configuration is not required, a point-to-point interface (for example, X.21) to the separate router may be used instead of a LAN interface, thus retaining more of the original hardware when converting end systems originally conforming to IEC 60870-5-101.

Other compatible selections from RFC 2200 are also permitted.

This standard uses the TCP/IP transport profile as defined in other referenced standards, without alteration.

Transport Interface (user to TCP interface)

RFC 793 (Transmission control protocol)		<b>Transport (layer 4)</b>
RFC 791 (Internet protocol)		<b>Network (layer 3)</b>
RFC 1661 (PPP)	RFC 894 (Transmission of IP datagrams over ethernet networks)	<b>Data link (layer 2)</b>
RFC 1662 (PPP in HDLC-like framing)		
X.21	IEEE 802.3	<b>Physical (layer 1)</b>
Serial line	Ethernet	

*IEC 2787/2000*

**Figure 3 – Selected standard provisions of the TCP/IP protocol suite RFC 2200 (example)**

## 5 Definition of Application Protocol Control Information (APCI)

The transport interface (User to TCP interface) is a stream-oriented interface which does not define any start or stop mechanism for the ASDUs of IEC 60870-5-101. In order to detect the start and the end of the ASDUs, each APCI includes the following delimiting elements: a start character, the specification of the length of the ASDU, plus the control field (see figure 4). Either a complete APDU (or, for control purposes, only the APCI fields) may be transferred (see figure 5).

NOTE The abbreviations used above are taken from clause 5 of IEC 60870-5-3 as follows.

APCI Application Protocol Control Information

ASDU Application Service Data Unit

APDU Application Protocol Data Unit