

Telecontrol equipment and systems —

Part 5: Transmission protocols —

Section 5 Basic application functions

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- Association of Consulting Engineers
- BEAMA Ltd.
- BEAMA Metering Association (BMA)
- EEA (Association of Electronics, Telecommunications and Business Equipment Industries)
- Electricity Association
- GAMBICA (BEAMA Ltd.)
- Transmission and Distribution Association (BEAMA Ltd.)

This British Standard, having been prepared under the direction of the Electrotechnical Sector Board, was published under the authority of the Standards Board and comes into effect on 15 February 1996

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The following BSI references relate to the work on this standard:
Committee reference PEL/57
Draft for comment 90/25650 DC

ISBN 0 580 24898 4

Amendments issued since publication

Amd. No.	Date	Comments

Contents

	Page
Committees responsible	Inside front cover
National foreword	ii
Foreword	2
Text of EN 60870-5-5	5
List of references	Inside back cover

National foreword

This British Standard has been prepared by Technical Committee PEL/57 and is the English language version of EN 60870-5-5:1995 *Telecontrol equipment and systems — Part 5: Transmission protocols — Section 5: Basic application functions*, published by the European Committee for Electrotechnical Standardization (CENELEC). It is identical with IEC 870-5-5:1995 published by the International Electrotechnical Commission (IEC).

Cross-references

Publication referred to	Corresponding British Standard
IEC 50(371):1984	BS 4727 <i>Glossary of electrotechnical, power, telecommunication, electronics, lighting and colour terms</i> Part 2 <i>Terms particular to power engineering</i> Group 12:1990 <i>Telecontrol terminology</i>
IEC 870-1-1:1988	BS 7404 <i>Telecontrol equipment and systems</i> Part 1 <i>General considerations</i> Section 1.1:1991 <i>General principles</i>
EN 60870-5-1:1993 (IEC 870-5-1:1990)	BS EN 60870 <i>Telecontrol equipment and systems</i> Part 5 <i>Transmission protocols</i> Section 5.1:1994 <i>Transmission frame formats</i>
EN 60870-5-2:1993 (IEC 870-5-2:1992)	Section 5.2:1994 <i>Link transmission procedures</i>
EN 60870-5-3:1992 (IEC 870-5-3:1992)	Section 5.3:1992 <i>Specification for general structure of application data</i>
EN 60870-5-4:1993 (IEC 870-5-4:1993)	Section 5.4:1993 <i>Definition and coding of application information elements</i>
ISO 7498:1984	BS 6568 <i>Reference model of open systems interconnection</i> Part 1:1988 <i>Basic reference model (incorporating connectionless-mode transmission)</i>

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, the EN title page, pages 2 to 50, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

Descriptors: Telecontrol, data transmission, open systems interconnection, application layer, protocol, basic application function, communication service, transmission procedure, enhanced performance architecture, application service, station initialization, acquisition of events, general interrogation, clock synchronization, command transmission, file transfer

English version

Telecontrol equipment and systems
Part 5: Transmission protocols
Section 5: Basic application functions

(IEC 870-5-5:1995)

Matériels et systèmes de téléconduite
Partie 5: Protocoles de transmission
Section 5: Fonctions d'application de base
(CEI 870-5-5:1995)

Fernwirkeinrichtungen und -systeme
Teil 5: Übertragungsprotokolle
Hauptabschnitt 5: Grundlegende
Anwendungsfunktionen
(IEC 870-5-5:1995)

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European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: rue de Stassart 35, B-1050 Brussels

Foreword

The text of document 57/200/DIS, future edition 1 of IEC 870-5-5, prepared by IEC TC 57, Power system control and associated communications, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 60870-5-5 on 1995-07-04.

The following dates were fixed:

- latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 1996-04-01
- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 1996-04-01

Annexes designated “normative” are part of the body of the standard. In this standard, Annex ZA is normative. Annex ZA has been added by CENELEC.

Contents

	Page
Foreword	2
Introduction	5
1 Scope and object	5
2 Normative references	5
3 Definitions	5
4 Application services	6
4.1 Application service primitives	6
5 General concept of application functions	7
6 Basic application functions	8
6.1 Station initialization	10
6.2 Data acquisition by polling	24
6.3 Cyclic data transmission	26
6.4 Acquisition of events	26
6.5 Acquisition of events by quick-check procedures	27
6.6 General interrogation — Outstation interrogation	29
6.7 Clock synchronization	31
6.8 Command transmission	33
6.9 Transmission of integrated totals (telecounting)	36
6.10 Parameter loading	38
6.11 Test procedure	40
6.12 File transfer	40
6.13 Acquisition of transmission delay	48
Annex ZA (normative) Normative references to international publications with their corresponding European publications	49
Figure 1 — Basic application services	7
Figure 2 — Location of communication services and application functions in the EPA (enhanced performance architecture) model	7
Figure 3 — Sequential procedure, general initialization procedure	11
Figure 4 — Sequential procedure, initialization of the controlling station in unbalanced transmission systems	13
Figure 5 — Sequential procedure, local initialization of the controlled station in unbalanced transmission systems	15
Figure 6 — Sequential procedure, remote initialization of the controlled station in unbalanced transmission systems	17

	Page
Figure 7 — Sequential procedure, initialization of the controlling station in balanced transmission systems	19
Figure 8 — Sequential procedure, local initialization of the controlled station in balanced transmission systems	21
Figure 9 — Sequential procedure, remote initialization of the controlled station in balanced transmission systems	23
Figure 10 — Sequential procedure, polling procedure	25
Figure 11 — Sequential procedure, cyclic data transmission	26
Figure 12 — Sequential procedure, acquisition of events	27
Figure 13 — Sequential procedure, acquisition of events by quick-check procedures	28
Figure 14 — Sequential procedure, outstation interrogation procedure	30
Figure 15 — Sequential procedure, clock synchronization procedure, embedded in time-tagged event transmission procedures	32
Figure 16 — Sequential procedure, command procedures	35
Figure 17 — Sequential procedure, acquisition of integrated totals	37
Figure 18 — Sequential procedure, parameter loading	39
Figure 19 — Sequential procedure, test procedure	40
Figure 20 — General construction of a file	41
Figure 21 — Sequential procedure, file transfer (monitor direction) concluded	43
Figure 22 — Sequential procedure, file transfer (control direction) concluded	46
Figure 23 — Sequential procedure, acquisition of transmission delay	48

Introduction

This section of IEC 870-5 specifies an assortment of basic application functions for use in telecontrol systems.

1 Scope and object

This section of IEC 870-5 applies to telecontrol equipment and systems with coded bit serial data transmission for monitoring and controlling geographically widespread processes. It defines basic application functions that perform standard procedures for telecontrol systems. Basic application functions are application procedures that reside beyond layer 7 (application layer) of the ISO reference model for open communication systems. The defined application procedures utilize standard services of the application layer. The specifications of this section serve as basic standards for different companion standards that will be elaborated in detail for specific telecontrol tasks. Each companion standard may use a specific selection of the defined functions. Basic application functions, which are not in this section but are found necessary for defining telecontrol companion standards, should be specified in these companion standards. Only the definition of companion standards will enable interoperability among compatible telecontrol equipment.

The general structure of application service data units (ASDUs) used by procedures specified in this section are defined in IEC 870-5-3.

Standards specified in this section are compatible with standards defined in sections 1 to 4 of IEC 870-5 (see clause 2).

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this section of IEC 870-5. At the time of publication, the editions indicated were valid. All normative documents are subject to revision, and parties to agreements based on this section of IEC 870-5 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 50 (371):1984, *International Electrotechnical Vocabulary (IEV) — Chapter 371: Telecontrol*.

IEC 870-1-1:1988, *Telecontrol equipment and systems — Part 1: General considerations — Section 1: General principles*.

IEC 870-5-1:1990, *Telecontrol equipment and systems — Part 5: Transmission protocols — Section 1: Transmission frame formats*.

IEC 870-5-2:1992, *Telecontrol equipment and systems — Part 5: Transmission protocols — Section 2: Link transmission procedures*.

IEC 870-5-3:1992, *Telecontrol equipment and systems — Part 5: Transmission protocols — Section 3: General structure of application data*.

IEC 870-5-4:1993, *Telecontrol equipment and systems — Part 5: Transmission protocols — Section 4: Definition and coding of application information elements*.

ISO 7498:1984, *Information processing systems — Open Systems Interconnection — Basic Reference Model*.

3 Definitions

For the purpose of this section of IEC 870-5, the following definitions apply:

3.1

basic application function (in telecontrol)

transmission procedure that performs a supervisory or control function that is generally used in telecontrol systems

Examples: command transmission, event transmission, cyclic transmission, etc.

3.2

companion standard

a companion standard adds semantics to the definitions of the basic standard or a functional profile. This may be expressed by defining particular uses for information objects or by defining additional information objects, service procedures and parameters of the basic standard

NOTE Companion standards do not alter the standards to which they refer, but make explicit the relationship between those used together for a specific domain of activity.

3.3

enhanced performance architecture (EPA)

a protocol reference model that provides, compared with the full seven-layer architecture according to the OSI basic reference model (ISO 7498), a three-layer architecture for obtaining faster response times for the critical information, but with service limitations

3.4

compound data field (CP)

a sequence of data fields with successive bit allocations that forms an information element

3.5

control direction

the direction of transmission from the controlling station to a controlled station

3.6

monitor direction

the direction of transmission from a controlled station to the controlling station

4 Application services

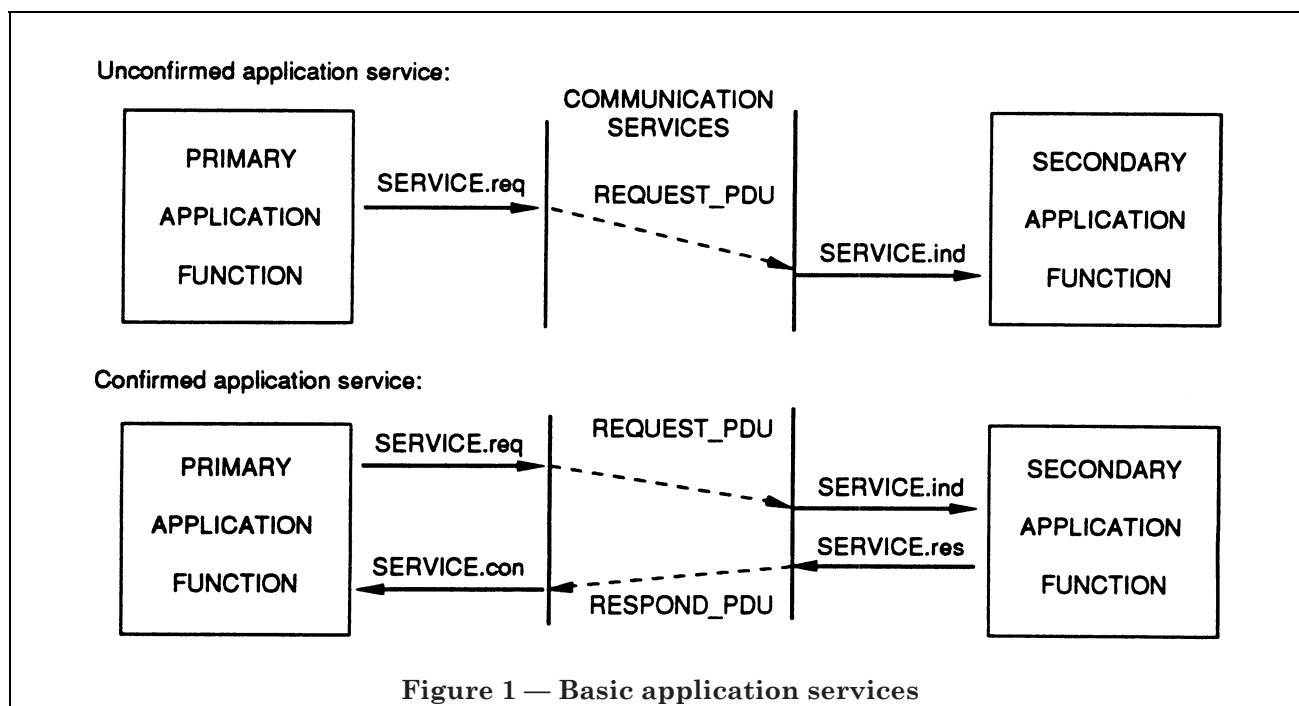
Each application process can have a “primary application function” and a “secondary application function”. A “primary application function” is part of an application process that initiates application requests to a remote application process by means of a “secondary application function” belonging to the latter.

Requested tasks are executed via communication services that involve the transmission of protocol data units (PDUs). Sequential procedures of communication services are described by means of sequences of service primitives.

4.1 Application service primitives

A primary application initiates a function by a service request primitive “request”. Confirmed application services require responses from the secondary application. The secondary application returns associated responses by service response primitives that are delivered to the primary application by service confirm primitives (see Figure 1).

Service.request (.req)	The primary application initiates a request by this service primitive to a remote secondary application function via the communication services.
Service.indication (.ind)	The communication services use this service primitive to deliver the service indication request to the secondary application function.
Service.response (.res)	The secondary application function uses this service primitive to respond to a request from the communication services.
Service.confirm (.con)	The communication services use this service primitive to deliver the response of the secondary to the primary application function.

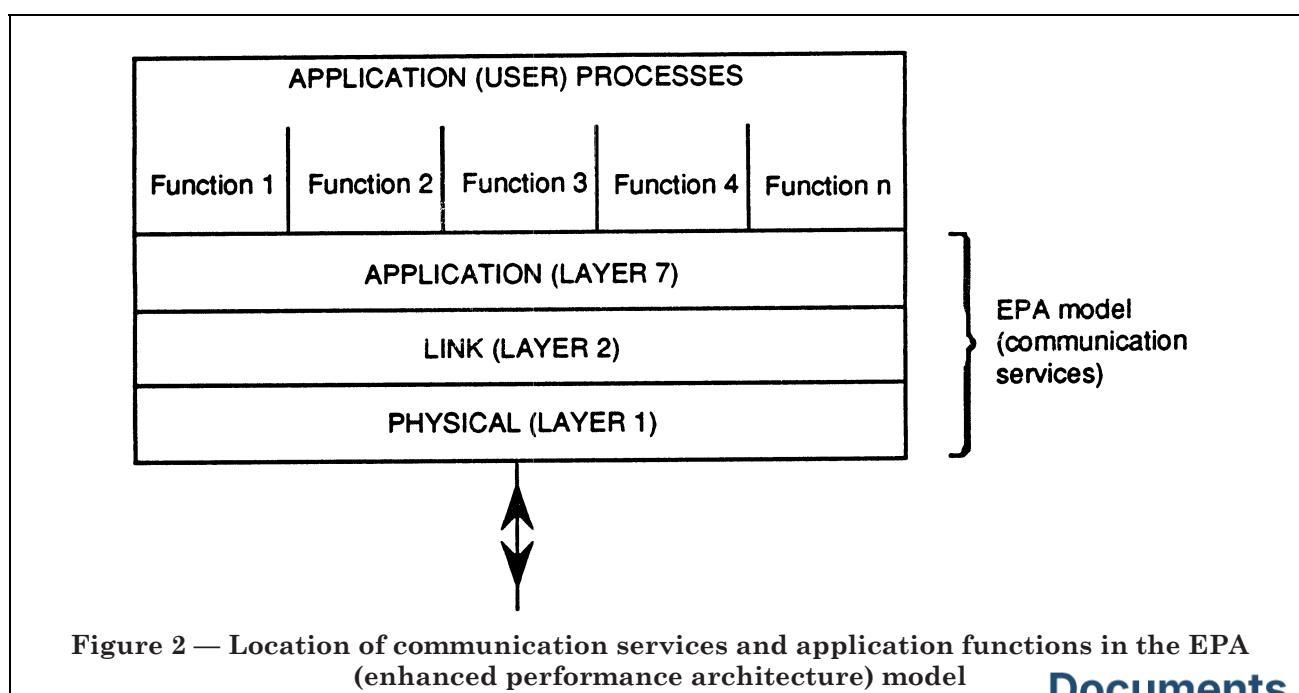


5 General concept of application functions

Application processes that involve peer-to-peer communication to perform coordinated procedures between remote locations use means that are offered in the layers 7, 2 and 1 of the EPA model (see Figure 2).

More than one procedure (in different stations) may be in progress at the same time. However the following application function procedures are described individually. The procedures are defined in single hierarchical presentation. Additional definitions for the use of multi-hierarchical telecontrol networks (e.g. network with concentrator station) should be specified in the companion standards.

The individual application functions use service primitives and elements of transmission procedures of the layers 7, 2 and 1 that are specified in the sections 1 to 5 of IEC 870-5.



Application functions are the part of application processes which perform the remote communication procedures between application processes.

The following clauses of this section of IEC 870-5 define an assortment of basic application functions. Each function is composed of transfer procedures of specific ASDUs between remotely communicating application processes. Information contents, frame formats of the various PDUs and parameter lists of service primitives are specified by the chosen companion standards.

6 Basic application functions

This clause defines an assortment of basic application functions that utilize standard communication services. The functions are described by presenting diagrams that indicate the sequence of data units that are exchanged between controlling and controlled stations and by describing the tasks of these data units to accomplish the functions. The first two described basic application functions, namely station initialization and data acquisition by polling represent a base for the execution of further basic application functions. These two functions are performed by coordination of particular application and link services that are described in detail. Other basic application functions that may involve the utilization of polling procedures are then described without repeating details about this procedure.

Sequential transmission procedures are described by arrows. Each arrow represents a protocol data unit PDU. A hierarchic structure of letters will be used for naming APDUs or ASDUs which may be completed by the different companion standards. In IEC 870-5 protocol definitions ASDUs are the same as APDUs because there is no explicit APCI.

The ASDU-labels specified in the following table follow a hierarchical order, which offers the possibility of using global labels in this standard and specific ones in the different companion standards. The highest level distinguishes between:

<i>Kind of information Level 1</i>	<i>Label</i>
Monitored information	M
Control information	C
Parameter	P
File transfer	F

The second level defines:

<i>Kind of information Level 2</i>	<i>Label</i>
Monitored information	M
Single-point information	M_SP
Double-point information	M_DP
Measurements	M_ME
Events of protection	M_EP
Integrated totals	M_IT
Step position information	M_ST
Bit and octet strings	M_BO
End of initialization	M_EI
Application layer available	M_AA
Control information	C
Single command	C_SC
Double command	C_DC
Set-point command	C_SE
Regulating step command	C_RC
Interrogation command	C_IC
Clock synchronization command	C_CS
Delay acquisition	C_CD
Counter interrogation command	C_CI
Test command	C_TS
Reset process command	C_RP
Read command	C_RD
End of initialization	C_EI

Parameter	P
Parameter for measurements	P_ME
Parameter activation	P_AC
File transfer	F
Directory	F_DR
Select or call file, section or directory	F_SC
Last section or segment	F_LS
ACK file or section	F_AF
File ready	F_FR
Section ready	F_SR
Segment	F_SG

The third level is used by the different companion standards and defines the specific type of the ASDU, the use of a time tag, etc. The first letter of the third level specifies the availability of a time tag (N = no time tag, T = time tag), the second letter specifies the type. Each companion standard may define its own types in alphabetical order beginning with "A". For example:

Measurement, normalized value without time tag (type A)	M_ME_NA
or	
Measurement, scaled value with time tag (type B)	M_ME_TB
or	
Single command, type A without time tag	C_SC_NA

In addition, a final number is appended to indicate which companion standard defines the ASDU label. For example:

Companion standard 101	M_ME_NA_1 or C_SC_NA_1
Companion standard 102	M_ME_NA_2 or C_SC_NA_2

This label system is open and may be completed, if necessary, in all hierarchical levels by the different companion standards.

ASDUs which are used in control direction may be mirrored in monitor direction. These mirrored ASDUs are used for positive/negative acknowledgments and need to be distinguished unambiguously in both directions. Therefore, in addition to the labels, these ASDUs are marked with the following abbreviations in control and monitor direction.

Control direction:	Activation	ACT
Monitor direction:	Activation confirmation	ACTCON
Control direction:	Deactivation	DEACT
Monitor direction:	Deactivation confirmation	DEACTCON
Monitor direction:	Activation termination	ACTTERM

In addition, the following abbreviations are used:

Monitor direction:	Cyclic transmission	CYCLIC
Monitor direction:	Spontaneous transmission	SPONT

When unbalanced transmission procedures are used, the ACT may be transmitted by a link service SEND/NO REPLY as a broadcast message (e.g. for station interrogation or clock synchronization). Then the ACTCON has to be transmitted back individually by each controlled station that received the ACT.

6.1 Station initialization

Station initialization procedures are required to set stations into correct operating states before the beginning of application-dependent telecontrol operations. It is necessary to distinguish between cold-start and warm-start procedures. A cold start is a primary bootstrap procedure of a station which means that information on process variables is cleared before starting to update the data base to the actual states. A warm start is a rebootstrapping procedure of a station that is reset or reactivated, which means that the information on process variables that was acquired before the reactivation is not cleared. A further distinction is the initialization of controlling and controlled stations. The following specifications consider mainly initialization procedures that involve data transmission between stations.

Controlling stations are frequently equipped with redundant control and data-base equipment that guarantees a switch-over without loss of information in case of failures of the active control equipment. In this case, there is no need to initialize a general interrogation to update the data base of the controlling station. However, after a power-up or a general reset of the whole controlling station, the general interrogation (see 6.6 and IEC 371-04-05) and, in some systems, clock synchronization (see 6.7) procedures are indispensable.

The controlled station may be reset by a local command or via a request from the controlling station.

6.1.1 Description of general initialization procedure (see Figure 3)

Figure 3 describes the initialization of the controlling and controlled station in general. Detailed definitions including the communication services used are given in subsequent figures.

Initialization of controlling station

After the internal initialization of the controlling station the link layer establishes connections to the controlled stations (see 6.1.2, 6.1.5 and IEC 870-5-2). When the controlling station is ready to process information of the controlled stations, it may send C_EI (End of Initialization) to the connected controlled stations (optional). After receiving this C_EI PDU the controlled stations may send process information to the controlling station. The controlling station then proceeds with the function general interrogation (see 6.6) and optionally clock synchronization (see 6.7).

Initialization of controlled station

If necessary, after the internal initialization of the controlled station, the link layer establishes the connection to the controlling station (see 6.1.3, 6.1.6 and IEC 870-5-2). If the controlled station is ready to process information of the controlling station, it may send a M_EI PDU to the controlling station (optional). After receiving this PDU the controlling station proceeds with general interrogation (see 6.6) and — in some systems — with clock synchronization (see 6.7).

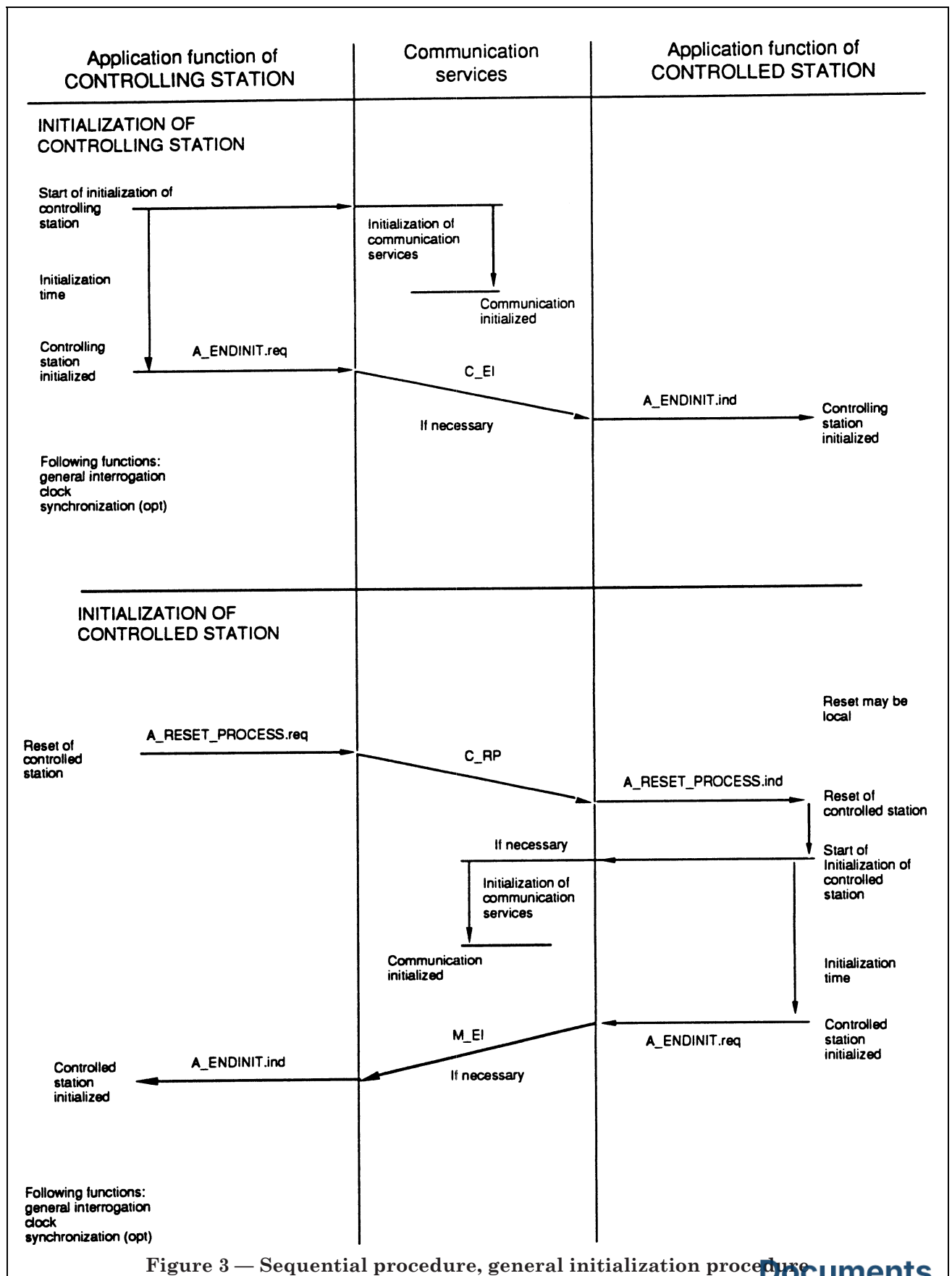


Figure 3 — Sequential procedure, general initialization procedure

**6.1.2 Initialization of the controlling station in unbalanced transmission systems
(description of sequential procedure, see Figure 4)**

If a “Start local initialization” occurs just after data have been requested from the controlled station (for example as shown dotted in Figure 4), then the link of the controlling station cannot receive the requested data because it is no longer available. After the start of initialization of the controlling station, the link layer is usually reset and made available earlier than the other internal functions of the controlling station during its initialization. The link of the controlling station then establishes connection to the link of the controlled station by transmitting a “Request status of link” that is answered by “Status of link”. To accomplish link synchronization, the controlling station transmits a “Reset of remote link” that is answered by an “ACK”. This “ACK” confirms the start condition of the link layer of the controlled station (next frame count bit FCB = 1 expected, see 5.1.2 of IEC 870-5-2). The state of the remote link layer may optionally be interrogated by a “Request status of link”. After complete initialization of the application functions in the controlling station, the connection between the application functions may be established by transmitting a C_EI PDU to the controlled station. The transmission of the C_EI PDU is not required in systems that establish the link connection after the complete initialization of the application functions in the controlling station. After the initialization the controlling station is updated by performing a general interrogation (see 6.6) and proceeds — in some systems — with clock synchronization (see 6.7). After this, the ordinary telecontrol operations may begin.

