SLOVENSKI STANDARD
SIST EN 13757-5:2008

01-december-2008

Komunikacijski sistemi za merilnike in daljinsko odļ itavanje - 5. del: Brezģiļ no odļ itavanje

Communication systems for meters and remote reading of meters - Part 5: Wireless relaying

Kommunikationssysteme für Zähler und deren Fernablesung - Teil 5: Weitervermittlung

Systèmes de communication et de télérelevé des compteurs - Partie 5 : Relais sans fil

Ta slovenski standard je istoveten z: EN 13757-5:2008

ICS:

33.200	Daljinsko krmiljenje, daljinske meritve (telemetrija)	Telecontrol. Telemetering
35.100.10	Fiziļ ni sloj	Physical layer
35.100.20	Podatkovni povezovalni sloj	Data link layer

SIST EN 13757-5:2008 en

EUROPEAN STANDARD

NORME EUROPÉENNE

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ICS 33.200; 35.100.10; 35.100.20

English Version

Communication systems for meters and remote reading of meters - Part 5: Wireless relaying

Systèmes de communication et de télérelevé des compteurs - Partie 5 : Relais sans fil

Kommunikationssysteme für Zähler und deren Fernablesung - Teil 5: Weitervermittlung

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Management Centre: rue de Stassart, 36 B-1050 Brussels

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Foreword

This document (EN 13757-5) has been prepared by Technical Committee CEN/TC 294 “Communication systems for meters and remote reading of meters”, the secretariat of which is held by DS.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by April 2009, and conflicting national standards shall be withdrawn at the latest by April 2009.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

EN 13757 consists of the following parts, under the general title *Communication systems for meters and remote reading of meters:*

— *Part 1: Data exchange*

— *Part 2: Physical and link layer*

— *Part 3: Dedicated application layer*

— *Part 4: Wireless meter readout (Radio meter reading for operation in the 868 MHz to 870 MHz SRD band)*

— *Part 5: Wireless relaying*

— *Part 6: Local Bus*

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

1 Scope

This standard defines the requirements for the protocols to use when performing relaying in wireless meter readout networks. This document is an extension to Part 4 of EN 13757, *Wireless meter readout (Radio meter reading for operation in the 868 MHz to 870 MHz SRD band)*. It supports the routing of mode R2, but the routing of mode S and T is not supported.

The main use of this standard is to support routed wireless networks for the readout of meters.

NOTE Electricity meters are not covered by this standard, as the standardisation of remote readout of electricity meters is a task for IEC/CENELEC.

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.

EN 13757-1:2002, *Communication system for meters and remote reading of meters – Part 1: Data exchange*

EN 13757-3:2004, *Communication systems for and remote reading of meters – Part 3: Dedicated application layer*

EN 13757-4:2005, *Communication systems for meters and remote reading of meters – Part 4: Wireless meter readout (Radio meter readout for operation in the 868 MHz to 870 MHz SRD band)*

EN 60870-5-1:1993, *Telecontrol equipment and systems – Part 5: Transmission protocols – Section 1: Transmission frame formats (IEC 60870-5-1:1990)*

EN 60870-5-2:1993, *Telecontrol equipment and systems – Part 5: Transmission protocols – Section 2: Link transmission procedures (IEC 60870-5-2:1992)*

EN 62054-21, *Electricity metering (a.c.) – Tariff and load control – Part 21: Particular requirements for time switches (IEC 62054-21:2004)*

ETSI EN 300 220-1:2000, *ElectroMagnetic Compatibility and Radio Spectrum Matters (ERM); Short Range Devices (SRD); Radio equipment to be used in the 25 MHz to 1 000 MHz frequency range with power levels ranging up to 500 mW; Part 1: Technical characteristics and test methods*

ETSI EN 300 220-2:2000, *ElectroMagnetic Compatibility and Radio Spectrum Matters (ERM); Short Range Devices (SRD); Radio equipment to be used in the 25 MHz to 1 000 MHz frequency range with power levels ranging up to 500 mW; Part 2: Supplementary parameters not intended for conformity purposes*

ETSI EN 301 489-1:2008, *Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 1: Common technical requirements*

ETSI EN 301 489-3:2002, *Electromagnetic compatibility and Radio spectrum Matters (ERM);ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 3: Specific conditions for Short-Range Devices (SRD) operating on frequencies between 9 kHz and 40 GHz*

RFC 1662 July 1994, *HDLC-like Framing, Appendix C. Fast Frame Check Sequence (FCS) Implementation*

3 Terms and definitions

For the purpose of this European Standard, the following terms and definitions apply.

3.1
primary station
network node that controls all of the data exchange in a simple network with one central node, unbalanced data transfer and multiple remote nodes

NOTE All data transfer will (normally) be controlled by the primary station. A data collecting unit will be a primary station.

3.2
secondary station
node in a hierarchical network that is able to receive commands and requests from a central node, the primary station, and to send a response back to the central node

NOTE A meter will be a secondary station.

3.3
upstream
transmission of data in the direction from the meter to the data collecting unit

3.4
downstream
transmission of data in the direction from the data collecting unit to the meter

3.5
relaying
forwarding of information from one logical network to another

NOTE A function performed by an intermediate node connected to two logical networks.

3.6
gateway
intermediate node in a data communications network, connected to two or more logical networks, where the protocols or modes used on the logical networks are different

3.7
router
intermediate node in a data communications network, connected to two or more logical networks with identical protocols and modes

3.8
node
unit in a network that is able to send and receive data

3.9
end node
meter or data collecting unit

3.10
intermediate node
node in a network sitting in between a data collecting unit and a meter

3.11
hop
transfer of a set of data from one node to an adjacent node, as one of the steps in the transfer of data between end nodes

3.12
frame
set of user data encapsulated by a header and optionally a trailer

NOTE For an EN 60870-5-1 based protocol, this will be a start character followed by up to 16 blocks of data.

3.13
block
sub-element of a frame

NOTE For an EN 60870-5-1 based protocol, this will be up to 16 bytes of user data completed by a CRC check.

4 Explanation

4.1 General

This clause is an explanatory clause. The specific requirements are to be found in the latter clauses of this European Standard.

4.2 Introduction

The availability of low cost radio modules has made it feasible to use radio communication for the readout of meter data. Many meters are battery operated and have a very strict power budget and regulatory requirements are imposed as well. This limits the transmitting power levels and thereby the useful distance between transmitters and receivers. The use of reinforced concrete, conductive surface coatings and placement of meters in the basement of the buildings aggravates the problem of directly communicating between a data collecting unit and a meter. This limits the useful size radio networks unless relaying or forwarding is used. By letting some of the nodes forward or relay data, the effective size of the network can be increased. This makes the radio based networks a more cost effective solution.

A relaying or forwarding concept will still have a number of constraints. The cost of adding this capability to the meters must be low, since meters are cost sensitive high volume products. The limited energy and computing power available in the individual nodes, mandates a limited complexity of the software handling the communications protocol and the forwarding.

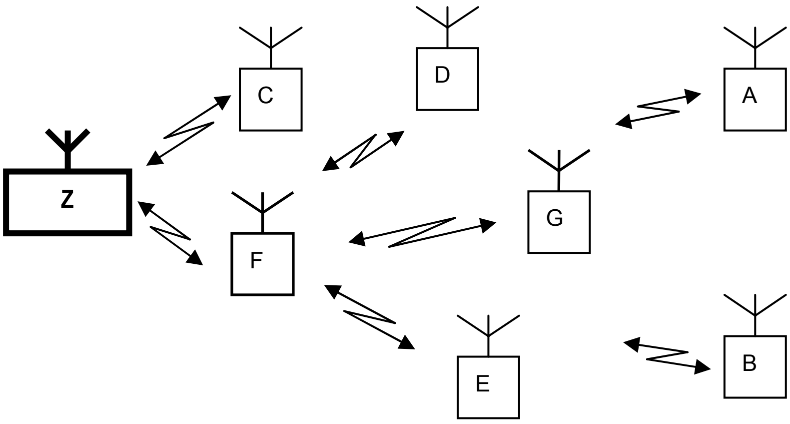
Operating and installation costs are important factors when planning for meter networks. The reconfiguration of the network when adding, replacing or removing meters must be automated to limit the operating cost.

The overhead due to relaying of data transmitted must be low to keep the transmission duty cycle within the limitations imposed by the authorities.

Radio networks for remote readout of meters are basically hierarchical networks. There is basically only one single data collecting node. All the meters send their data to this node, some directly, and some through forwarding nodes. There is basically no requirement for communication between meters as peer nodes.

4.3 Relaying

A radio network may have a structure like the one shown in Figure 1 below. The nodes A, B, C, D, E, F and G are simple meters. They all need to communicate with node Z, the data collecting unit/the primary station. In the current setup only nodes C and F are able to reach node Z. The other nodes cannot reach node Z. The useful size of this network is thereby limited to only 2 nodes, nodes C and F.

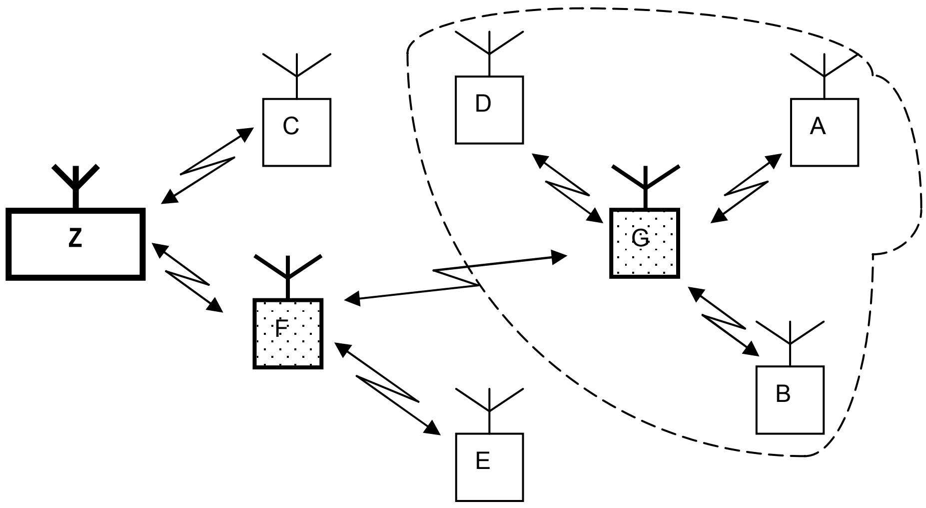


Key

A – G simple meters
Z data collecting unit/primary station

Figure 1 — Network with simple nodes, without relaying

Extending the network by adding some nodes with relaying capability will give a structure as shown in Figure 2. Nodes F and G have now been extended to include relaying capability. Communication between nodes A, B and D and the primary station is achieved by relaying the data through nodes G and F. Node A sends data to node G, node G relays data to node F and node F relays data to node Z, the data collecting unit. The size of the network can now be extended to include all of the nodes shown. Nodes F and G may be dedicated relaying nodes or meters with extended capabilities. Transmission from one node to another is called a hop. The transmission from node A to the data collecting unit/primary station consists of three hops.

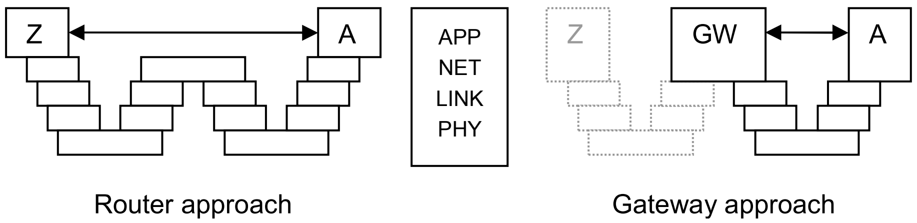


Key

A – E simple meters
F, G nodes with relaying capability
Z data collecting unit/primary station

Figure 2 — Network with relaying nodes

Note that the network still has a hierarchical structure at the application level, despite the relaying nodes. All end-to-end data transfer is performed between the data collecting unit and the meters. The meters do not communicate with one another at the application level, nor do the relays.



Key

A meter
GW node with relaying capability
Z data collecting unit/primary station

Figure 3 — Router vs. gateway solution

The relaying can be performed in two different ways as shown in Figure 3, using either a gateway or a router approach.

In the router approach all nodes in the network are aware of the other nodes in the network and they all use the same protocol in both directions. The nodes are aware of the routing capability of certain nodes as well. Node B, as shown in Figure 2, will know that it for instance has to send data through the relaying nodes G and F to reach the data collecting unit.

In the gateway approach only the locally reachable nodes are known. Nodes beyond the gateway are hidden. For nodes A, B and D in Figure 2, the network is limited to the area inside the dashed line, and node E is to all subordinate units the 'data collecting unit'. The gateways are organised in a hierarchy of networks as well, as shown in Figure 2, where node E is at the bottom of the hierarchy, node F is one level above it and node Z, the real data collecting unit, is at the top level.

The generic details of the gateway and the router approach are specified in the following subclauses.

4.4 Use of routers

In a routed network the nodes all behave like peer entities at the network level. Transfer between nodes is based on pairs of addresses, the sender node address and the receiver node address. This allows for a non-hierarchical structure of the nodes in a network with parallel paths.

The fact that a pair of addresses is needed makes the routed approach incompatible with the data link layer used in EN 13757-4. There is thus a need of being able to distinguish between native EN 13757-4 data and routed data at the data link layer. This to ensure that simple nodes don't try to decode and handle routed data by mistake.

The way of selecting the path to use when sending a package through a network can be determined in two ways. The first is the hop-by-hop method. Here the full path is set up prior to the first transmission, and it includes all the nodes to connect through. The second method uses network generated paths. Here the first node sends the data to a suitable neighbour router, and this router then determines the next hop for the data, based on its routing information. This latter method is the one used by the IP protocol on the Internet. The approach selected for this application is the hop-by-hop addressing method, as this is less complex to implement and requires less network traffic overhead and less intelligence in the nodes in the network.

4.5 Use of gateways

4.5.1 General

A simple node has only a single address field. It is only able to work in a network with a single primary station controlling the network and one or more secondary stations/meters. A simple node will, when receiving data, look for its own address in the address field. It will assume that all data sent to it originates from the primary station. A simple node will, when responding, include its own address in the header. It will assume that all data will be received by the primary station.

The gateway hides the network and network complexity from the simple nodes. To the nodes the gateway appears as the primary station. If the network shown in Figure 2 is using the gateways approach, then node G will appear as the primary station to node A, B and D. Node E will assume that node F is the primary station, and only node C will actually connect directly to node Z, the data collecting unit.

EN 13757-4 uses the approach of simple nodes. This makes the gateway approach backward compatible to EN 13757-4 units.

A gateway node may be a dedicated node or a meter with extended functionality.

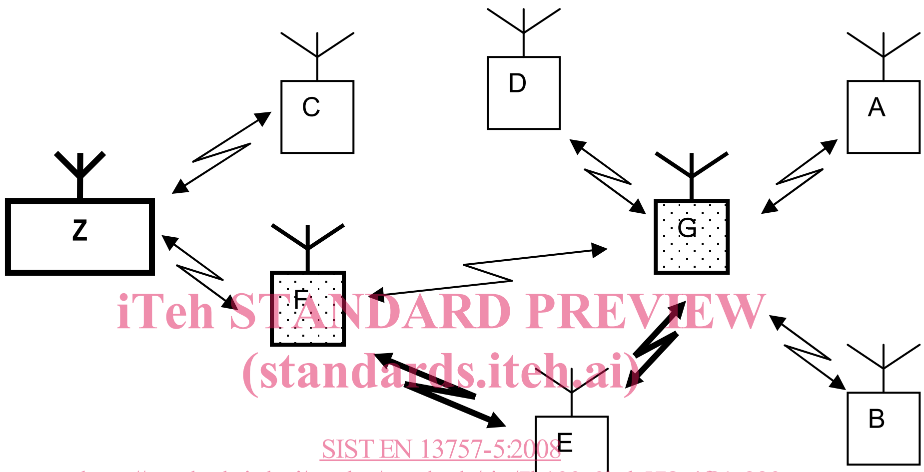
The gateway will, when sending data downstream to the simple node(s), appear like the primary station. It will send data to the simple nodes in the format specified in EN 13757-4 for the R2 mode. It will, when receiving data sent upstream from a simple node, appear like a primary station. It will accept data in the format as specified in EN 13757-4 for the R2 mode.

The gateway does not have any prior knowledge of the overall network configuration. Relaying of data must then either be based on fixed rules, or on information provided in the header of the data. Both of these approaches are used in this gateway protocol.

The gateway may, when data are sent upstream, use the generic rule that the network is hierarchical. The gateway will, when it has received data from a simple node to be sent upstream, forward them further upstream. Data will then be received by another gateway or the primary station. There is no need for destination addressing of data sent upstream.

4.5.2 Data duplication

Not all data sent upstream should be forwarded, as this may cause data duplication. This is can be seen in Figure 4 below.



Key

A – E simple meters
F, G nodes with relaying capability
Z data collecting unit /primary station

Figure 4 — Data duplication

Data sent by node E can be received by gateway G as well as by gateway F. When node E sends a set of data, it will be received by both gateways. One set of data will be sent along the path E – G – F to node Z, the data collecting unit, and another set of data will be sent along the path E – F to node Z. The use of unconditional relaying will cause duplication of the data received by the data collecting unit and cause unnecessary traffic on the network as well. Methods and rules need to be implemented to ensure that data duplication is avoided.

Two issues should be handled when looking into avoidance of data duplication:

a) whether to use enabling or disabling lists;

b) whether to use a list of local or global nodes.

The nature of radio communication is that the actual transmitting distance may vary a lot over time. It is thus not feasible to generate a list of nodes not allowed to relay for. Special transmitting conditions, due to for instance special metrological conditions, may make it possible to hear nodes located far away. It is as well possible that a new operator, also following this European Standard, could set up new nodes that weren't known when the initial network was set up. Data from the new nodes is not to be performed by default, but there is no possibility of knowing the coming of these nodes in advance. These are examples of situations that cannot be handled orderly by a disabling list. An enabling list is therefore to be used.

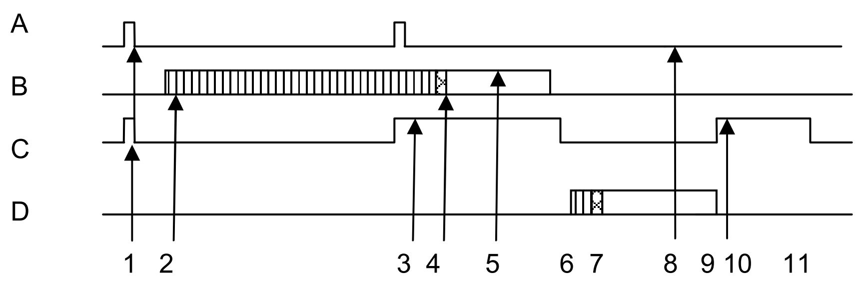
The use of a global list of nodes would require that nodes at the higher levels of the hierarchy must contain very large lists holding the address of all subordinate units it is to receive data from. All possible intermediate nodes have to contain information about all their subordinate nodes as well. This would require a lot of data memory in the gateways and cause a lot of network traffic when the lists are to be updated. The use of a local list has therefore been evaluated as superior, and selected. The use of a local list has the minor drawback that data sent upstream must contain the (local) address of the sending node, as well as the address of the originator, the meter.

More specific requirements will be explained in detail in the subclauses on gateways.

The gateway will need further address information when it receives data to be sent downstream. It must know what node(s) to forward the data to. This information, network control information, is to be available as a part of the header of the data.

4.6 Use of power strobed units

Many meters and intermediate nodes are battery operated and have to operate from a single battery for several years. This makes it necessary to conserve power by switching off part of the circuits in the node when not in use. One such part is the radio. This is further described in Figure 5. The control program in a node may, when the node isn't communicating, only switch on the receiver briefly with fixed intervals (1, 3). This listening will be disabled when the node is transmitting (8). Another node wanting to communicate with the power strobed node must then send a wake-up signal (2). The power-strobed receiver will, during its listening interval, look for data transfer of the expected type (a wake-up signal), and will switch off again if no data transfer is detected (1). The receiver shall, once wake-up is detected (3), look for a synchronisation pattern (4) and start to collect data (5). The receiver may, if the destination address of the information doesn't match that of the node, switch off to conserve power. A node should, after the transmitter in the node has been active (6, 7, 9), switch on the receiver for a period (10, 11) in anticipation of a response to the transmitted message. Such behaviour will improve the processing of the data and limit the duty cycle, as no wake-up sequence is needed.



Key

A receiver ‘listening’ window
B wake-up and data signal
C receiver active
D data transmitted

Figure 5 — Power strobed receiver

The duration of the wake-up sequence shall be long enough so that it is detected by the node during the first listening interval to ensure an effective data transfer, i.e. it must be longer than the listening interval of the receiver.

To prevent unnecessary wake-up of meters, the wake-up signal uses a different data rate than normal data transfers. On-going data transfers between nodes will not awake sleeping nodes, thus saving power.

The parameters specifying power wake-up behaviour should be standardised to ensure energy efficient data transfer in the radio network.

4.7 Error handling

The data error rate will be higher in a radio based network than in a wired network. Some of the reasons for this are:

— the units are operating in a license free band, where a lot of other units may be operating at the same time. Such units may garble or block the transmission between a pair of nodes in the metering network;

— noise from other sources may impair the signals;

— the radio transmission conditions may change due to changes in the environment (new building erected, container placed in front of the meters) or changes in weather conditions;

— the transmission of information from a meter to the data collecting unit may traverse multiple links. The overall transmission is only successful if all of the individual hops, forth and back, are successful.

All this makes it necessary to use efficient error handling algorithms in a radio based relayed network. To alleviate the error handling, the following concepts are implemented in the protocols used:

— data transmission is acknowledged for each hop;

— there is a fast acknowledge at the link layer;