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Real-time Ethernet P-NET on IP specification

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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Real-time Ethernet P-NET on IP specification

FOREWORD

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IEC-PAS 62412 has been processed by subcommittee 65C: Digital communications, of IEC technical committee 65: Industrial-process measurement and control.

The text of this PAS is based on the following document:	This PAS was approved for publication by the P-members of the committee concerned as indicated in the following document
Draft PAS	**Report on voting**
65C/360/NP	65C/376/RVN

Following publication of this PAS, the technical committee or subcommittee concerned will transform it into an International Standard.

It is intended that the content of this PAS will be incorporated in the future new edition of the various parts of IEC 61158 series according to the structure of this series.

This PAS shall remain valid for an initial maximum period of three years starting from 2005-08. The validity may be extended for a single three-year period, following which it shall be revised to become another type of normative document or shall be withdrawn.

INTRODUCTION

The P-NET on IP specification is designed for use in an IP-environment. P-NET on IP enables use of P-NET (IEC 61158, type 4) real-time communication wrapped into UDP/IP packages.

P-NET packages can be routed through IP-networks in exactly the same way as they can be routed through non-IP-networks. Routing can be through any type of P-NET network and in any order.

Nodes on an IP-network are addressed with two P-NET Route elements, but this is entirely handled by the IP-nodes. This means that any P-NET client (master) can access servers on an IP-network without knowing anything about IP-addresses.

Real-time Ethernet P-NET on IP specification

1 Scope and object

This PAS consists of paragraphs that are meant to be additional to the definitions and specifications, which are already found in the IEC 61158 series. Following each heading, there will be a reference to which paragraph must be inserted or replaced within the relevant IEC 61158 series.

After the modifications to IEC 61158 series a few descriptions explain how to perform address conversions and handle dynamic clients.

NOTE These descriptions are more implementation specific and will not be included in the normative parts of the new 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 61158-2:2003, *Digital data communications for measurement and control – Fieldbus for use in industrial control systems – Part 2: Physical layer specification and service definition*

IEC 61158-4:2003, *Digital data communications for measurement and control – Fieldbus for use in industrial control systems – Part 4: Data link protocol specification*

ISO/IEC 8802-3, *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 768 (UDP, User Datagram Protocol)

RFC 791 (IP, Internet Protocol)

3 Conventions

This PAS specifies paragraphs that shall either be replaced or added to the IEC 61158 series.

Paragraphs that shall be replaced are indicated with the paragraph number(s) in question as reference and begin and end with the lines as shown:

---------------------------------- Replace begin -------------------------------

modified text

---------------------------------- Replace end -------------------------------

Paragraphs that shall be added are indicated with first paragraph number(s) to add and begin and end with the lines as shown:

---------------------------------- Addition begin -------------------------------

new text

---------------------------------- Addition end -------------------------------

4 61158-2 Physical Layer specification

----------------------------------- Addition begin -------------------------------

ISO/IEC 8802-3 shall be used.

4.1 OSI Data Link Layer

4.1.1 MAC sublayer

ISO/IEC 8802-3 shall be used.

4.1.2 LLC sublayer

ISO/IEC 8802-3 shall be used.

4.2 OSI Network layer

Internet standard RFC 791 (IP, Internet protocol) and its amendments and successors shall be used.

4.3 OSI Transport layer

Internet standard RFC 768 (UDP, User Datagram Protocol) and its amendments and successors and the Data Link Layer protocol specification within this document shall be used.

----------------------------------- Addition end -------------------------------

5 61158-4 Data Link Layer protocol specification

5.1 Terms and definitions

5.1.1 P-NET-route

The following term is to be replaced in 3.7.8, Type 4: Additional terms and definitions:

---------------------------------- Replace begin --------------------------------

A P-NET route holds a sequence of P-NET-route-elements.

NOTE A P-NET-route is defined as an encoded DL-route, with one of the formats used when transmitting the DLPDU on the Link. The P-NET-route format can be Simple, Extended, Complex, Immediate or IP.

---------------------------------- Replace end --------------------------------

5.2 Additions to terms and definitions

The following terms are to be added in paragraph 3.7, Type 4: Additional terms and definitions:

---------------------------------- Addition begin --------------------------------

5.2.1 IPNetTable

An IpNetTable defines the relation between IPNetID, IP address, UPD port number and Router NodeAddress, where IPNetID is used as index in the table.

5.2.2 IPNetID

IPNetID identifies a unique IP network. The value of IPNetID shall be in the range of 0-127. The values 0, 126 and 127 are reserved for special purposes.

NOTE An IPNetID is translated into an IP-address and a UPD port number.

5.2.3 UDP port number

A Server can receive requests on two different UPD port numbers: Normal UDP port and Secure UDP port. UDP port number shall be 34378 for Normal UDP port. UDP port number shall be 34379 for Secure UDP port.

NOTE These UDP port numbers are registered with the IANA (Internet Assigned Numbers Authority)

5.2.4 Nettype

An IP network is of a certain type, a Nettype that can be “Unused”, “IP Range net” or “UDP Range net”.

5.2.5 IP Range net

An IP Range net is used for local access, where nodes can be accessed directly on the same subnet as the client, or through a local Router where the subnets are configured in the local Router.

5.2.6 UDP Range net

A UDP Range net is used for remote access, where a node cannot be accessed directly on the same subnet as the client. The IPNetTable holds a NAT Router IP address and access to the node is obtained through this NAT Router.

NOTE The NAT Router shall hold a table that translates the UDP port number to the actual server node IP address and UDP port number.

---------------------------------- Addition end --------------------------------

5.3 Type 4: Additional symbols and abbreviations

5.3.1 Constants, variables, counters and queues

The following paragraph shall be added to paragraph 4.5.1, Type 4: Additional symbols and abbreviations:

---------------------------------- Addition begin -------------------------------

5.3.1.1 **IPNetTable** **Table to convert IPNetID to IP-addresses**

---------------------------------- Addition end -------------------------------

5.4 Type 4: Data Link Protocol Definition

5.4.1.1 Half-duplex and full duplex

The following paragraphs are to be replaced in paragraph 24.1.2.2, Type 4: Data Link Protocol Definition:

---------------------------------- Replace begin -------------------------------

Unless otherwise stated, the PhL is assumed to support half-duplex transfer. However, a PhL supporting full duplex is allowed.

Full duplex systems allow up to 125 DLEs on a Link, all of Normal class. Each DLE is allowed to transmit immediately, that is, there is no Link Access system. DLEs supporting full duplex PhEs have separate state machines for receive and transmit, as illustrated in Figure 91 to Figure 92.

In full duplex systems, as well Confirmed as Unconfirmed DLPDUs are unacknowledged.

PhLs supporting full duplex shall not provide Link-Idle indications.

---------------------------------- Replace end -------------------------------

5.4.1.2 Responder role, receiving a DLPDU from the PhE

The following paragraphs are to be replaced in 24.1.2.5, Type 4: Data Link Protocol Definition:

---------------------------------- Replace begin -------------------------------

This action includes a sequence of steps, as described in the following.

a) Receive a single PhIDU specifying START-OF-ACTIVITY. This PhIDU holds a Node address. This address is examined to determine, whether its value is equal to the Node-address of this DLE, or equal to the Broadcast-Node-address (BNA) or the Service-Node-Address (SNA). If not, ignore this sequence and wait for the next PhIDU specifying START-OF-ACTIVITY.

b) Receive a sequence of PhIDUs from the PhE, specifying DATA, concatenate them to a received DLPDU, compute a frame check sequence over the entire sequence of received data as specified by the value of V(FCM) - FrameCheckMethod, and, if necessary, check for the proper value. If the value is not correct, ignore the DLPDU and wait for the next PhIDU specifying START-OF-ACTIVITY.

c) Convert the received DLPDU into its DL-protocol control information and data components.

d) Generate a DLS-user indication primitive.

e) If the DLPDU received from the remote DLE is of type Confirmed, and the receipt of the DLPDU must be acknowledged, according to the rules described in 24.1.2.1, wait for a request or response primitive from the local DLS-user.

If no request or response primitive is issued from the local DLS-user in time (before a PhIDU specifying "LINK-IDLE for 30 bit periods" is received from the PhE), generate and immediately send an Acknowledge DLPDU. This DLPDU must specify "Wait" if this DLE is of Simple class, and "Response Comes Later / Acknowledge" ("RCL/ACK") if this DLE is of Normal class.

If a response primitive is issued from the local DLS-user in time, generate and immediately send an Acknowledge DLPDU, specifying "Wait" if this DLE is of Simple class, and "RCL/ACK" if this DLE is of Normal class.

If a request primitive is issued from the local DLS-user in time, convert it into an Immediate-reply DLPDU and send it immediately. After sending, wait for the next PhIDU specifying START-OF-ACTIVITY.

f) If the DLPDU received from the remote DLE is of type Confirmed, and the receipt of the DLPDU shall not be acknowledged, wait for the next PhIDU specifying START-OF-ACTIVITY.

g) If the DLPDU received from the remote DLE is of type Unconfirmed, and the receipt of the DLPDU must be acknowledged, according to the rules described in 24.1.2.1, generate and immediately send an Acknowledge DLPDU, specifying RCL/ACK. After sending, wait for the next PhIDU specifying START-OF-ACTIVITY.

h) If the DLPDU received from the remote DLE is of type Unconfirmed, and the receipt of the DLPDU shall not be acknowledged, wait for the next PhIDU specifying START-OF-ACTIVITY.

----------------------------------- Replace end --------------------------------

5.4.2 PhIDU structure and encoding

The following paragraphs are to be replaced in 24.2.1, Type 4: Data Link Protocol Definition:

----------------------------------- Replace begin --------------------------------

Each PhIDU consists of Ph-interface-control-information and in some cases one octet of Ph-interface-data (see 24.1.3). When the DLE transmits a DLPDU, it computes a frame check sequence for the DLPDU as specified in 24.2.2, concatenates the DLPDU and the frame check sequence, and transmits the concatenated pair as a sequence of PhIDUs as follows:

a) The DLE issues a single Ph-DATA request primitive with PhICI specifying START-OF-ACTIVITY-2 if sending from the queue, and specifying START-OF-ACTIVITY-11 if sending an Acknowledge or Immediate-reply DLPDU, or if re-transmitting because of missing acknowledge. The request primitive is accompanied by one octet holding the first octet from the DLPDU as Ph-interface-data. After that, the DLE awaits the consequent Ph-DATA confirm primitive.

b) The DLE issues a sequence of Ph-DATA request primitives with PhICI specifying DATA, each accompanied by one octet of the DLPDU as Ph-interface-data, from second to last octet of the DLPDU, and after each Ph-DATA request primitive awaits the consequent Ph-DATA confirm primitive.

c) If the value of V(FCM) - FrameCheckMethod - specifies reduced frame check, the DLE issues a single Ph-DATA request primitive with PhICI specifying DATA, accompanied by