EPSG Draft Standard 302-D

Ethernet POWERLINK

Part D: Multiple PReq/PRes

Version 1.1.1

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Pre. 2 History

Vers.	Date	Author		short description
0.0.1	2009-06-10	Stephan Kirchmayer	B&R	created
0.0.2	2009-06-25	Stephan Kirchmayer	B&R	PDO_RxCommParam_XXh_REC, PDO_TxCommParam_XXh_REC sub-index 3
0.0.3	2009-09-04	Stephan Kirchmayer	B&R	Figure and additional object description added
0.0.4	2009-10-13	Stephan Kirchmayer	B&R	Feedback from TWG meeting 9/2010
0.1.0	2013-03-29	Stephan Kirchmayer	B&R	Minor layout changes, status changed to DSP
1.0.0	2013-12-18	Stephan Kirchmayer	B&R	Minor layout changes, category changed for D_DLL_MultiplePReqPRes_BOOL to M status changed to DS
1.0.1	2018-03-14	Stephan Kirchmayer	B&R	Feedback from TWG meeting 03/2018
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Pre. 3 Content

Pre. 4 Tables

Pre. 5 Figures

Pre. 6 Definitions and Abbreviations

Pre. 6.1 Definitions

Pre. 6.2 Abbreviations

Pre. 7 References

[1] EPSG Draft Standard 301 (EPSG DS 301), Ethernet POWERLINK, Communication Profile Specification

1 Introduction

For a Controlled Node the existing POWERLINK specification restricts the amount of isochronous payload data that can be sent to 1490 bytes.

The Managing Node may only send 1490 bytes in its PResMN frame additionally.

Conversely, this means that a node cannot receive more than 1490 bytes of isochronous data from another node. (except additional 1490 bytes from PResMN)

This extension is to overcome the limitation mentioned above.

1.1 Overview

The extension utilizes unused node numbers to be able to send more data to and from a node. These node numbers are additionally assigned to Multi-PReq/PRes capable Controlled Nodes by the Managing Node.

A Multi-PReq/PRes capable node shall reply to such a PReq frame by a PRes with the dedicated virtual node number.

The configuration is done via existing PDO mapping configuration and an additional object for assigning the virtual node numbers to the real Controlled Nodes.

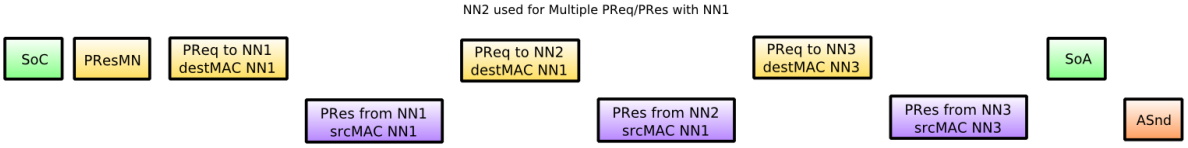

Fig. 1. Multiple PReq/PRes cycle overview

For network management the Managing Node uses the regular node numbers only. The additional virtual nodes are just for PDO mapping and sending and receiving PReq/PRes frames. An error on one of these frames is handled like an error on the regular frame of the real existing node. The particular error counters are only incremented ones whether a frame to/from the real or virtual node number or both frames trigger an error handling.

1.2 Summary of features

- Maximum of 252 PReq/PRes frames per cycle
- Each Controlled Node may map more than 254 objects per PDO.
- Crosstraffic from Multi-PReq/PRes nodes to conventional nodes and v.v. possible
- Fully compatible with conventional Controlled Nodes

2 PDO configuration

2.1 Assignment of node IDs used in frames to real nodes

A new object 1F94h NMT_PdoNodeAssign_AU8 is used to assign all used node IDs to the real node IDs of the nodes present in the network.

The sub-index is the node ID indicated in the PReq/PRes frames and the value hold by this sub-index is the real node ID.

See chapter 6.5 for object description.

2.2 Rx mapping

The source (in PRes) resp. destination (in PReq) address of the Rx mapping is described by the objects 1400h .. 14FFh PDO_RxCommParam_XXh_REC.

By [1] the sub-index 1 holds the node ID. The value 0 is reserved for the PReq addressed to this node. So far all other values indicate a PRes, i.e. on Controlled Nodes crosstraffic from other nodes. The sub-index 2 gives the mapping version.

If there is more than one PReq frame addressed to a node, one is sent with the destination ID equal to the node ID of the Controlled Node. All other PReq frames are sent with different node IDs.

On Controlled nodes a sub-index 3 shall be added to PDO_RxCommParam_XXh_REC holding the message type of the receive frame. Sub-index 1 still holds the node ID but if sub-index 1 is not equal 0 this new sub-index 3 indicates, if the Rx frame is a PReq or a PRes frame.

Note: By this it is also possible to configure the receiving of the own PRes.

See 6.1 for object description

Alternatively a Controlled Node may check NMT_PdoNodeAssign_AU8 to be able to distinguish between a PReq and a PRes frame. The node ID indicated in PDO_RxCommParam_XXh_REC sub-index 1 gives the sub-index of NMT_PdoNodeAssign_AU8. If the value of a sub-index of NMT_PdoNodeAssign_AU8 is equal the own node ID, the frame is a PReq otherwise a PRes. If the value of PDO_RxCommParam_XXh_REC sub-index 1 is 0 the frame is a PReq as defined in [1].On a Managing Node the Rx mapping is as defined in [1].

2.3 Tx mapping

The source (in PRes, PResMN) resp. destination (in PReq) address of the Tx mapping is described by the objects 1800h .. 18FFh PDO_TxCommParam_XXh_REC.

The sub-index 1 holds the node ID. In conventional POWERLINK networks [1] this value is not valid on Controlled Nodes because there is only one TPDO. The sub-index 2 gives the mapping version.

With this extension sub-index 1 is also used on Controlled Nodes because more than one TPDO may be mapped.

Now, on a Controlled Node sub-index 1 holds the source node ID of the TPDO. This may be the real node ID or the virtual node ID depending on the configuration. If the value of the sub-index is 0 the own node ID shall be used.

On the Managing Node sub-index 1 holds the destination node ID of the PReq resp. the source node ID of the PResMN frame. It is the source node ID of the PResMN if the value of the dedicated sub-index in the object 1F94h NMT_PdoNodeAssign_AU8 is the node number of the Managing Node (240).

2.4 Multiplexing of a virtual node

The Managing Node shall use the object 1F9Bh (NMT_MultiplCycleAssign_AU8) to assign a virtual node to a multiplexed slot like it is done for real nodes.

If a real node is multiplexed also all of its assigned virtual nodes shall be multiplexed too and vice versa. However the virtual PReq/PRes frames can be assigned to different multiplexed slots.

2.5 Payload Limits

The Managing Node shall use the object 1F8Bh (NMT_PReqPayloadLimitList_AU16) to assign the PReq payload limit of a virtual node like it is done for real nodes.

The Managing Node shall use the object 1F8Dh (NMT_PresPayloadLimitList_AU16) to to assign the PRes payload limit of a virtual node like it is done for real nodes. A Controlled Node shall support the object if it supports virtual node IDs.

The actual PReq and PRes frame sizes for virtual nodes shall be derived from the mapped data. 1F98h sub-index 4 and 5 (PReq-/PResActPayloadLimit) shall be used for the PReq and PRes of the real node only.

3 Special boot-up procedures

PReq/PRes frames to/from virtual nodes shall be sent in the NMT states NMT_CS_READY_TO_OPERATE and NMT_CS_OPERATIONAL of the CN only.

Note: Sending virtual PReq/PRes frames in NMT_CS_PRE_OPERATIONAL_2 may result in collisions, e.g. if a node with a stored configuration with virtual node IDs is plugged into a different network, it may receive PReq frames to its virtual node IDs and respond with PRes frames because the configuration is not yet updated. This may result in collisions with PRes frames from another real node with its node ID equal to a former virtual node ID.

4 Error Handling

Loss of PReq resp. PRes theshold counting shall be done individual for each real and virtual node ID. The threshold for virtual node IDs shall be the same as for the real node ID. The Loss of PReq resp. PRes error handling shall be triggered if at least one individual error counter (real or virtual) reaches its threshold value.

There shall be no additional objects for the Loss of PRes cummulation and threshold counters regardless of the number of virtual node IDs configured on a node. The already existing objects shall be used for the real node ID.

5 Mapping of more than 254 objects into one PDO

One pair of mapping objects (PDO_RxCommParam_XXh_REC, PDO_RxMappParam_XXh_AU64 or PDO_TxCommParam_XXh_REC, PDO_TxMappParam_XXh_AU64) is usually assigned to one isochronous PReq or PRes frame. Up to 254 objects may be mapped by each of these objects. This value results from the maximum number of sub-indices possible.

However, mapping of more than 254 objects into one PDO frame can be achieved by using more than one pair of mapping objects per frame.

The POWERLINK specification [1] does not forbid such a design.

In case of Tx frames it shall be assured that the ranges in the frame do not overlap each other.

6 Additional object description

6.1 Object 1400h .. 14FFh: PDO_RxCommParam_*XX*h_Rec

This description handles a sequence of up to 256 objects. These indices describe the communication attributes of the RPDO channels. Mapping version, address information and message type are provided.

Index	1400h .. 14FFh	Object Code	RECORD
Name	PDO_RxCommParam_XXh_REC		
Data Type	PDO_CommParamRecord_TYPE	Category	Cond

- **Sub-Index 00_h: NumberOfEntries**

Sub-Index	00_h		
Name	NumberOfEntries		
Value Range	3	Access	const
Default Value	3	PDO Mapping	No

- **Sub-Index 03_h: RxMessageType_U8**

Sub-Index	02_h		
Name	RxMessageType_U8		
Data Type	UNSIGNED8	Category	M
Value Range	0,3,4	Access	rws / ro
Default Value	-	PDO Mapping	No

Access shall be ro if only static mapping is provided by the device.

Value	Description
0	Not used. Value interpretation of sub-index 1 (= NodeID_U8) as usual
3	PReq (= message type PReq)
4	PRes (= message type PRes)

Tab. 1 RxMessageType_U8 value interpretation

6.2 Object 1800h .. 18FFh: PDO_TxCommParam_*XX*h_Rec

This description handles a sequence of up to 256 objects. These indices describe the communication attributes of the TPDO channels. Mapping version and address information are provided.

Index	1800h .. 18FFh	Object Code	RECORD
Name	PDO_TxCommParam_XXh_REC		
Data Type	PDO_CommParamRecord_TYPE	Category	Cond

- **Sub-Index 01_h: NodeID_U8**

Sub-Index	01_h		
Name	NodeID_U8		
Data Type	UNSIGNED8	Category	M
Value Range	0, 1 .. 254	Access	rws
Default Value	-	PDO Mapping	No

Node ID of the PDO:

- CN: Real or virtual node ID of the PRes source. 0 may be used to indicate real node ID.

- MN: Real or virtual node ID of the PReq destination or node ID of the PResMN source. 0 may be used to indicate PResMN with source node ID 240.

6.3 Object 1F81h: NMT_NodeAssignment_AU32

This object assigns nodes to the NMT Master (MN). On the Controlled Node the object is conditional. See [1] for more details.

Each sub-index in the array corresponds to the node with the node ID equal to the sub-index.

The object should be set by the system configuration.

Additional bit used:

Index	1F81h	Object Code	ARRAY
Name	NMT_NodeAssignment_AU32		
Data Type	UNSIGNED32	Category	MN: M CN: Cond

- **Sub-Index 01h .. FEh: NodeAssignment**

Sub-Index	01h .. FEh		
Name	NodeAssignment		
--	--	Category	M
Value Range	Bit field, see below	Access	rw, valid on reset
Default Value	0	PDO Mapping	No

Octet	Bit	Value	Description	Property	Evaluate
2	16	0b	Conventional node	CN	MN, CN
		1b	Virtual node		

Tab. 2 NMT_NodeAssignment_AU32 additional bit interpretation

6.4 Object 1F82h: NMT_FeatureFlags_U32

The Feature Flags indicate communication profile specific properties of the device given by its design. The object shall be setup by the device firmware during system initialisation.

Additional bit used:

Octet	Bit	Name	TRUE	FALSE
2	19	Multiple PReq/PRes	Device supports Multiple PReq/PRes	Device does not support Multiple PReq/PRes
			D_DLL_MultiplePReqPRes_BOOL	

Tab. 3 NMT_FeatureFlags_U32 additional bit interpretation

6.5 Object 1F94h: NMT_PdoNodeAssign_AU8

This object assigns virtual node IDs to the real node IDs of the nodes present in the network.

The object should be set by the system configuration.

Index	$1F94_h$	Object Code	ARRAY
Name	NMT_PdoNodeAssign_AU8		
Data Type	UNSIGNED8	Category	MN: M CN: O

- **Sub-Index 00_h: NumberOfEntries**

Sub-Index	00_h		
Name	NumberOfEntries		
Value Range	1..254	Access	rw
Default Value	254	PDO Mapping	No

- **Sub-Index 01_h .. FE_h: NodeID**

Sub-Index	01_h .. FE_h		
Name	NodeID_U8		
--	--	Category	M
Value Range	0 .. 254	Access	rw
Default Value	0	PDO Mapping	No

Each sub-index in the array corresponds to the virtual node with the virtual node ID equal to the sub-index. The value hold by a sub-index is the real node ID.

If NodeID_U8 is zero the sub-index equals to the real node ID by default.

App. 1 Device Description Entries (normative)

Additional device description entries:

Name	Description	Type	Category		Default	
			MN	CN	MN	CN
D_DLL_MultiplePReqPRes_BOOL	Ability of a node to perform multiple PReq/PRes functions	BOOLEAN	M	M	N	N