

Description

Active publishing

5 The invention relates to a communication or
data exchange method for use in connection with a
decentralized bus system, in particular a field bus,
which can be employed in the automation of technical
processes, and to which a plurality of communication
10 parties, including at least two masters and at least
one slave, are connected, in which each is assigned to
one master system in each case, in which the master
system has no physical counterpart, but defines only
the possibility or impossibility of certain communica-
15 tion relationships between the communication parties
connected to the bus system, in which at least the
slave detects every telegram transmitted over the bus
and evaluates at least certain data of the telegram
header and, when said data matches entries stored in a
20 filter table, makes the data of the telegram available
to its application.

A communication or data exchange method which
improves communication between the parties connected to
the field bus is, for example, so-called cross-terminal
25 traffic in which, for example, data can be exchanged
directly between so-called passive communication sta-
tions, referred to below as "slaves", despite the fact
that according to the communication protocol defined
for the field bus no direct communication relationship
30 can be established between such passive communication
parties, and to date communication has always had to
take place with the intermediary of a so-called active
communication party, referred to below as "master", in
that a communication relationship is established
35 between the first passive communication party and such
a master, and the data are transferred to the master,
whereupon the master establishes a communication rela-
tionship to the second passive communication party and
thus the data finally reach the

second passive communication party, the actual recipient.

5 An active communication party, a master, is a communication party in a bus system which can autonomously initiate a communications operation, whereas a passive communication party, a slave, is a communication party which, in order to place data on the bus, always requires an external stimulus, for example a send request from a master.

10 The object of the present invention is to optimise communication in a field bus system and between the communication parties connected to the field bus system while utilizing the possibilities of cross-terminal traffic.

15 This object is achieved with a communication method for use in connection with a decentralized bus system which can be employed in the automation of technical processes, and to which a plurality of communication parties, including at least two masters and at least one slave, are connected, in which each master is
20 assigned to one master system in each case, in which the master system has no physical counterpart, but defines only the possibility or impossibility of certain communication relationships between the communication parties connected to the bus system, in which at
25 least the slave detects every telegram transmitted over the bus and evaluates at least certain data of the telegram header and, when said data matches entries stored in a filter table, makes the data of the telegram available to its application, in that a data
30 transfer to a slave of a first master system starting from a master of a remote master system is accomplished by the data of the telegram header being suitable for passing through the filter table of the slave.

One advantageous refinement of the communication method according to the invention is that for the slave, the telegram sent by the master does not differ, at least with respect to the telegram header, from a telegram of a communication party of the same master system sent in the context of so-called cross-terminal traffic.

A refinement of this type can further be extended in that the telegram sent by the master is identified by an internal code as a "response", so that the telegram issued by the master of the master system appears to the slave of the master system as a cross-terminal traffic telegram that could be triggered by a stimulus of its own master.

Further features, advantages and possible applications of the invention emerge from the sub-claims, the description of an exemplary embodiment below, with reference to the figures, and the figures themselves. All the features described and/or diagrammatically illustrated here form, by themselves or in any combination, the subject-matter of the present invention irrespective of their grouping in the claims or to what the claims refer back.

In the drawings,

FIG 1 shows a simple bus topology,
FIG 2 shows an identification of the master systems established on the bus, and
FIGS 3a, 3b,
4a, 4b show the telegram structure and the layout of the filter table in the context of cross-terminal traffic.

FIG 1 shows a bus topology having a bus system B and communication parties connected to the bus system B, with two masters M1, M2 and three slaves S1, S2, S3 being shown as examples of communication parties.

It is of course possible to connect more than the masters and slaves shown in FIG 1 to the bus system B.

In the case of the already known cross-terminal traffic, the advantages and capabilities of which are described in the not yet published European patent application 97102093.8 (filing date: 10.02.97), a communication relationship can be established in such a form that a send request is sent by an active communication party, e.g. the master M1, to at least one of the slaves, e.g. the slave S1. The slave S1 reacts by placing the requested data on the bus B in the form of a telegram. With this method, the data placed on the bus have a code, for example in the telegram header, which identifies the slave S1 as the sender, and have a further code which identifies the master M1, for example, as the recipient. The other communication parties connected to the bus system, in particular the slaves S2, S3, listen in to the traffic on the bus B and while doing so register in particular the telegram from the slave S1 to the master M1. In order to be able to participate in cross-terminal traffic, the communication parties have a filter table in which the information as to which telegrams traveling over the bus the cross-terminal traffic party should register is stored, even if said telegrams are not directly addressed to that party's destination address. If, therefore, an entry is stored for the slave S3 in its filter table in the form "sender: S1, recipient: M1", the slave S3 accepts telegrams with this code and makes them available to its applications. In this way, the path via a master M1 is dispensed with, since the data that have arrived directly at the slave S3 by means of cross-terminal traffic would otherwise have had to have been transmitted from the slave S1 to the master M1, and from the latter to the slave S3.

In an alternative form of cross-terminal traffic, a send request is sent by the master, for example again by the master M1, to at least one of the slaves,

for example again the slave S1, whereupon the slave S1 reacts by placing the requested

data on the bus, this time with a code that still identifies the slave S1 as the sender, but as recipient has a code that causes the telegram to be directed to all participating communication parties. Sending data in this way is also known as "publishing"; in the text below, therefore, whenever a sender places a telegram directed "to all" on the bus, this will be referred to as publishing. All communication parties that receive the telegram published by the slave S1 evaluate the received data on the basis of the already described filter table configured specifically for the respective communication party, and make the data available to their respective application where appropriate. The filter table as such essentially corresponds to the filter table already described, with the difference being that instead of clearly directed transmissions, e.g. starting from the slave S1 and directed to the master M1, being monitored, the published transmissions are monitored, the latter being identifiable as publishing on the basis of the code "to all" and additionally on the basis of the origin code.

Since the destination code is the same for each publishing, theoretically the filter table can therefore be reduced to the origin code (even if in practice provision may well additionally be made for inclusion of the service access point in the filtering as well). Formulated as text, a filter table of this type has the effect that it is agreed that for each passive communication party the publishings of specific other slaves are received and evaluated. According to the example, therefore, it could be specified that the publishings of slaves S1 and S2 are received and evaluated by the slave S3, that the publishings of communication parties S1 and S3 are received and evaluated by the communication party S2, and that the publishings of communication parties S2 and S3 are received and evaluated by the communication party S1.

A relationship exists between the respective communication parties, and hence in particular between the active communication parties and the passive communication parties assigned to them; this relationship results from the configuration. In the text below, this relationship will be referred to as a master system, because at least one master is always involved in the configured relationship.

According to FIG 2, three master systems MS1, MS2, MS3 are established on the bus system B, with the master system MS1 being formed from the master M1 and the slaves S1 and S2; analogously the master system MS2 comprises the communication parties M2, S3, and the master system MS3 comprises the communication party M3.

According to the fundamentally underlying standard EN 50170 Part II, communication relationships from a party of a first master system, e.g. MS1, to a party of a second master system, e.g. MS2, are not envisaged. On the one hand this is because, as a result of the configuration of the, for example, first master system MS1, the transport addresses of the members of the master system MS2 are not known, and consequently cannot be used in a communications operation initiated by a member of the first master system MS1. Moreover, the configured communication relationship between a master of a master system and the slaves assigned to it, has the effect that a recipient of a message from a remote master system detects that this message does not belong to the communication relationship configured for the master system. This results in the received message being rejected, and hence not registered and evaluated.

With cross-terminal traffic, however, one communication relationship between slaves of different master systems is possible, in that, for example, the master M1 of the master system MS1 sends a request, i.e. a send request, to the slave S2 assigned to the master system MS1, whereupon said slave publishes its data,

with the result that all the communication parties connected to the bus system, and hence also the communication parties of the master system MS2 for example, can listen into these data on the bus.

5 A passive communication party, e.g. the slave S3, which, like all the other communication parties, listens into this publishing of the slave S2 can evaluate the data and detect on the basis of a filter table configured for said slave S3 whether it should make the
10 received data available to its application. To this extent, communication from one master system to another master system is possible with cross-terminal traffic. Communication between communication parties of the same master system which normally cannot communicate
15 directly with one other, that is to say between two passive communication parties of the same master system for example, continues of course to be possible with cross-terminal traffic.

 What has not yet been possible, on the other
20 hand, is communication between a master of a first master system and a communication party of a further master system. It was already explained above that, for example, a direct communication relationship between the master M3 of the master system MS3 and the slave S2
25 of the master system MS1 fails because, for example, a recipient of a message from a remote master system detects that this message does not belong to the communication relationships configured for its own master system, so the message is rejected.

30 In order for the master M3 of the master system MS3 to be able to communicate with a communication party of the master system MS1, e.g. the slave S1, it must convert the data into a special format for sending on the bus, wherein in particular the header of the
35 telegram issued, the so-called telegram header, is distinguished by entries that can pass through the filter table of the passive communication party S1.

At least with respect to the header, the telegram sent by the master M3 therefore appears to the recipient, to the communication party S1, as if it had been sent by another communication party, an active or a passive communication party, in the context of cross-terminal traffic.

By virtue of the invention, therefore, the closed structure per se of the individual master systems is opened to the transmission of telegrams from communication parties of a first master system to communication parties of another master system.

This is accomplished in such a way that when the master M3, for example, wishes to output data to the slave S2, a telegram is generated for this purpose, which telegram is characterized by the fact that "to all" is entered as the destination address, and the address of the sender, i.e. in this case the address of the master M3, is entered as the source address. The slave S2 detects the telegram received from the master M3 as a telegram in a structure that it would accept in the context of cross-terminal traffic.

Alternatively, it is possible to arrange that the communication party S2 only accepts the telegram issued by the master M3 as a valid telegram for cross-terminal traffic if the telegram is identified as a "response" by an internal code, so that the telegram issued by the master M3 of the master system MS3 for the slave S2 of the master system MS1 represents a telegram in the context of cross-terminal traffic which may have been triggered by a stimulus, of its own master M1 for example.

The entries, in particular in the telegram header TH, and the corresponding data of the filter table FT are shown in Figures 3a, 3b and 4a, 4b. According to FIG 3a, the telegram T comprises a data part D and a header part, the telegram header TH. The telegram header TH comprises

at least positions for entering the source address QA and the destination address ZA. The destination address ZA identifies the recipient of the telegram, while the source address QA identifies the sender of the telegram. In addition, positions are provided which identify the telegram as a send request or request REQ, or as a reply to the send request, as a response RES. With respect to the identification as a request REQ or response RES, it is possible to provide for two separate entries in the telegram header, in which case, for example, the entry of a one at the corresponding position identifies the telegram as a request, while accordingly the other position would then of course have to contain a zero. Alternatively, it is also possible to provide for the telegram header to have only one position, in which a first entry identifies the telegram as a request and a different second entry identifies the telegram as a response.

FIG 3b shows the filter table FT, in which respectively associated source and destination addresses can be entered, with the source address and destination address entry of every telegram received being compared with the corresponding entries of the filter table. If a match is determined, the telegram is one which the communication party makes available to its applications.

The telegram T according to FIG 4a differs from the telegram T of FIG 3a by the fact that no explicit destination address is specified. Without an explicit destination address, the telegram is directed as it were "to all". Since the destination address information is no longer contained in the telegram T, the filter table FT according to FIG 4b is accordingly reduced to source address data. It should however be noted that, when the table according to FIG 3b or FIG 4b is reduced in each case to one entry relating to the station number, this information represents a minimum. According to one embodiment, therefore, it is provided that the table comprises in each case at least informa-

tion relating to the station number - for filtering with respect to the source address of received data - as well as additionally of the source SAPs - for filtering with respect to the SAP used when the incoming data were sent out.

If, as described above, it is provided that a telegram is only accepted as a valid telegram in the context of cross-terminal traffic if the telegram is identified by an internal code as a response, then no filtering in the form of a filter table is required for checking this code, since this is a simple if-then decision, with the telegram being accepted if the response code is detected, and the telegram being rejected otherwise.

As a consequence, the possibility also exists for active communication parties of remote master systems to send data to communication parties of a master system that is not contactable per se. The prerequisite for this is that said communication parties have a filter table of the type described above and compare at least the header of the telegram issued with the data entered in the filter table in accordance with the configuration, and when these match evaluate the data accordingly and make them available in the respective applications.

The novel communication method can be advantageously employed, for example, for applications where it is necessary to influence either all or a group of system components simultaneously or virtually simultaneously, which is the case, for example, in particular whenever the emergency stop function is to be triggered at an operator terminal.

With reference to FIG 2, for example, the emergency stop function would be monitored by the master M3 and as soon as the emergency stop is triggered, the master M3 sends a telegram according to the present invention to the communication parties of the other master systems. The application is of course not

limited to the handling of an emergency stop, but can also be used advantageously for example to trigger a "synchronous stop" or similar actions that require a certain synchronicity, or where quick communication to
5 all communication parties connected to the bus system is required.



Patent Claims

1. A communication method for use in connection with a decentralized bus system (B) which can be employed in the automation of technical processes, and to which a plurality of communication parties, including at least two masters (M1, M2) and at least one slave (S1), are connected, in which each master (M1, M2) is assigned to one master system (MS1, MS2) in each case, in which the master system (MS1, MS2) has no physical counterpart, but defines only the possibility or impossibility of certain communication relationships between the communication parties (M1, M2, S1) connected to the bus system (B), in which at least the slave (S1) detects every telegram transmitted over the bus (B) and evaluates at least certain data of the telegram header and, when said data matches entries stored in a filter table, makes the data of the telegram available to its application, characterized in that a data transfer to a slave (S1) of a first master system (MS1) starting from a master (M2) of a remote master system (MS2) is accomplished by the data of the telegram header being suitable for passing through the filter table of the slave (S1).
2. The communication method as claimed in claim 1, characterized in that for the slave (S1), the telegram sent by the master (M2) does not differ, at least with respect to the telegram header, from a telegram of a communication party of the same master system (MS1) sent in the context of so-called cross-terminal traffic.
3. The communication method as claimed in claim 2, characterized in that the telegram sent by the master (M2) is identified by an internal code as a "response", so that the telegram issued by the master (M3) of the master system (MS3) appears to the slave (S1) of the master system (MS1) as a cross-terminal traffic telegram that

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could be triggered by a stimulus of its own master
(M1).

