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(54) **Title:** MECHANISM FOR PROVIDING OR COLLECTING INFORMATION OF A COMPUTER-CONTROLLED PACKAGING PLANT, AND METHODS AND COMPUTER PROGRAMS THEREFOR

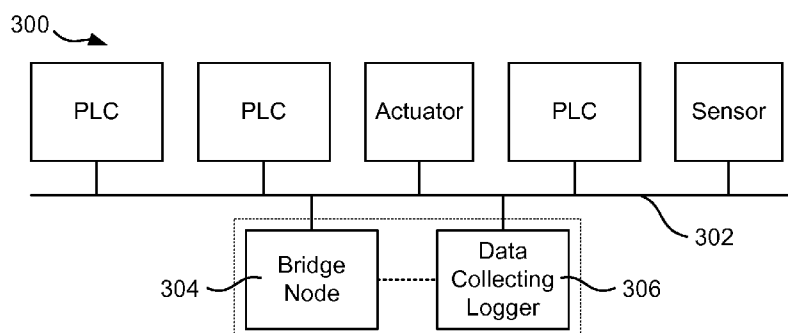


Fig. 3

(57) **Abstract:** A mechanism for providing information from computer-controlled packaging plant is disclosed. A packaging machine, a method and a computer program are also disclosed. At least one portion of the plant is controlled by a first programmable logic controller, PLC, connected to a first controller network. The mechanism comprises at least one output port of the first PLC as signed towards a bridge node of the first controller network. The first PLC is arranged to provide implicit communication data outputs to the output port such that a data collecting logger is enabled to read the implicit communication data through the first controller network and via the bridge node.



MECHANISM FOR PROVIDING OR COLLECTING INFORMATION OF A
COMPUTER-CONTROLLED PACKAGING PLANT, AND METHODS AND
COMPUTER PROGRAMS THEREFOR

5 Technical field

The present invention generally relates to mechanisms for providing or collecting information of a computer-controlled packaging plant, and methods and computer programs therefor.

10 Background

Traditionally, data logging has been a task for service personnel requiring special attendance and normally requiring the service personnel to be working with the data logging on site. This has at least two disadvantages: the logging may not be performed at time instants when seldom occurring events happen; and logging may
15 become a costly activity.

Designing new plants with data logging features may be possible, but the problem still remains for designs being used and which would be too costly to scrap because of this feature only.

It is therefore a desire to improve data logging by adapting present “off-the-
20 shelf” designs.

Summary

An object of the invention is to at least alleviate the above stated problem. The present invention is based on the understanding that by applying a bridge node to which
25 output ports of programmable logic controllers, PLCs, of the computer-controlled plants can be assigned, data logging can be performed without redesigning the whole control part of the plant. The inventors have realised that assignment of the output port towards the bridge node can thus be made very much like an assignment towards any hardware of the plant, e.g. a step motor, a valve, a servo or the like. This enables real-time data to
30 be provided to the output port which then is taken care on real-time basis by the bridge node, which in turn provides it to a data logger in any desired format. The solution thus enables the PLCs to work according to the real-time schedule, fulfilling real-time constraints thereof, and the data logger is enabled to work according to any schedule suitable which enables efficient memory and/or communication handling therein.

Real-time data that is conveyed on a controller network and is normally referred to as “implicit communication data” or “scheduled data”. Other data that is conveyed on the controller network is consequently normally referred to as “explicit communication data” or “unscheduled data”.

5 According to a first aspect, there is provided a mechanism for providing information from computer-controlled packaging plant, wherein at least one portion of the plant is controlled by a first programmable logic controller, PLC, connected to a first controller network. The mechanism comprises a bridge node of the first PLC assigning at least one output port towards the first controller network, wherein the first
10 PLC is arranged to provide implicit communication data outputs to the output port such that a data collecting logger is enabled to read the data through the first controller network.

 At least another portion of the plant may be controlled by a second PLC connected to a second controller network. The mechanism may then comprise a bridge
15 node of the second PLC assigning at least one output port towards the second controller network, wherein the second PLC is arranged to provide implicit communication data outputs to the output port such that the data collecting logger is enabled to read the data through the second controller network. The first and second controller networks may be idem. The first and/or second PLC is/may be arranged to receive a request for explicit
20 communication data and provide a response to said request by providing a data packet with the explicit communication data on the controller network to the data collecting logger. The explicit communication data outputs to the output port may be arranged according to EtherNet/IP Class 3.

 The implicit communication data outputs to the output port may be arranged
25 according to EtherNet/IP Class 1.

 According to a second aspect, there is provided a mechanism for collecting information from computer-controlled packaging plant, wherein at least one portion of the plant is controlled by a first programmable logic controller, PLC, connected to a controller network, wherein the first PLC comprises a bridge node assigning at least one
30 output port towards the controller network and the first PLC is arranged to provide implicit communication data outputs to the output port. The mechanism comprises a data collecting logger arranged to read the data through the controller network.

 The data collecting logger may be connected also to a communication network other than the controller network, wherein the data collecting logger is arranged to
35 redistribute the read data through the communication network to a remote computer.

The data collecting logger may be arranged to transmit a request for explicit communication data to the PLC and receive a response to said request comprising a data packet with the explicit communication data on the controller network from the PLC. The explicit communication data outputs at the output port may be arranged according to EtherNet/IP Class 3.

The implicit communication data outputs at the output port may be arranged according to EtherNet/IP Class 1.

According to a third aspect, there is provided a computer-controlled packaging plant arrangement, comprising a mechanism for providing information from the computer-controlled packaging plant according to the first aspect and a mechanism for collecting information from the computer-controlled packaging plant according to the second aspect.

According to a fourth aspect, there is provided a method for providing information from computer-controlled packaging plant, wherein at least one portion of the plant is controlled by a first programmable logic controller, PLC, connected to a first controller network, a mechanism comprising a bridge node of the first PLC assigning at least one output port towards the first controller network. The method comprises providing, by the first PLC, implicit communication data outputs to the output port such that a data collecting logger is enabled to read the data through the first controller network.

The method may further comprise receiving, from the data collecting logger, a request for explicit communication data; and providing, by the first PLC, a response to said request by providing a data packet with the explicit communication data on the controller network to the data collecting logger. The explicit communication data may be arranged according to EtherNet/IP Class 3.

The implicit communication data outputs to the output port may be arranged according to EtherNet/IP Class 1.

According to a fifth aspect, there is provided a method for collecting information from computer-controlled packaging plant, wherein at least one portion of the plant is controlled by a first programmable logic controller, PLC, connected to a controller network, wherein the first PLC comprises a bridge node assigning at least one output port towards the controller network providing implicit communication data outputs. The method comprises reading, by a data collecting logger, the data through the controller network.

The data collecting logger may be connected also to a communication network other than the controller network, wherein the method further may comprise redistributing, by the data collecting logger, the read data through the communication network to a remote computer.

5 The method may further comprise transmitting, through the data collecting logger, a request for explicit communication data to the PLC; and receiving, by the data collecting logger, a response to said request comprising a data packet with the explicit communication data on the controller network from the PLC.

10 According to a sixth aspect, there is provided a computer program comprising computer-executable program code comprising computer-readable instructions, wherein a processor, upon downloading and executing the program code by the processor, is caused to perform the method according to any of the fifth or sixth aspects.

15 Other objectives, features and advantages of the present invention will appear from the following detailed disclosure, from the attached dependent claims as well as from the drawings. Generally, all terms used in the claims are to be interpreted according to their ordinary meaning in the technical field, unless explicitly defined otherwise herein. All references to "a/an/the [element, device, component, means, step, etc]" are to be interpreted openly as referring to at least one instance of said element, device, component, means, step, etc., unless explicitly stated otherwise. The steps of
20 any method disclosed herein do not have to be performed in the exact order disclosed, unless explicitly stated.

Brief description of the drawings

25 The above, as well as additional objects, features and advantages of the present invention, will be better understood through the following illustrative and non-limiting detailed description of preferred embodiments of the present invention, with reference to the appended drawings.

Fig 1 illustrates data transmitted using for example the respective protocol stack as indicated for implicit messaging and explicit messaging.

30 Fig. 2 schematically illustrates a packaging machine according to an embodiment.

Fig. 3 schematically illustrates a controller network and examples of connected entities, for example a number of PLCs, according to an embodiment.

Fig. 4 illustrates a method according to an embodiment, performed at a PLC.

Fig. 5 illustrates a method according to an embodiment, performed at a data logger and/or bridge node.

Fig. 6 schematically illustrates a computer-readable medium for storing a computer program, and a computer for downloading and executing the computer program.

Detailed description

A complex automated industrial system, such as manufacturing assembly line, usually needs an organized hierarchy of controller systems to function. In this hierarchy there is usually a Human Machine Interface (HMI) at the top, where an operator can monitor or operate the system. This is typically linked to a middle layer of programmable logic controllers (PLC) via a non-time-critical communications system (e.g. Ethernet). At the bottom of the control chain there can be a fieldbus that links the PLCs to the components that actually do the work, such as sensors, actuators, electric motors, console lights, switches, valves and contactors. Until recently, a PLC would communicate with a slave machine using one of several possible open or proprietary protocols, such as Modbus, Sinec H1, Profibus, CANopen, DeviceNet or FOUNDATION Fieldbus. However, interest increased to use Ethernet as the link-layer protocol, with one of the above protocols as the application-layer (as in the OSI model). For example, Ethernet Industrial Protocol (EtherNet/IP) have been developed for the Ethernet transport layer. EtherNet/IP is a communications protocol managed by the Open DeviceNet Vendors Association (ODVA) and designed for use in process control and other industrial automation applications. It makes use of producer/consumer models for the exchange of time-critical data. Here, the producer is the sender of the data which transmits information to either one consumer, which is the reveiver, using unicast, or to multiple consumers using multicast, i.e. without having to transmit multiple times. This means that multiple devices can receive the same sequence of data from a single producing device.

The Common Industrial Protocol (CIP) is an industrial protocol for industrial automation applications. It is supported by Open DeviceNet Vendors Association, ODVA. It is previously also known as Control and Information Protocol, CIP, and encompasses a comprehensive suite of messages and services for the collection of manufacturing automation applications such as control, safety, synchronization, motion, configuration and information. It allows users to integrate these manufacturing applications with enterprise-level Ethernet networks and the Internet. It is supported by

many vendors around the world, and is media-independent. CIP provides a unified communication architecture throughout the manufacturing enterprise. The CIP is used in EtherNet/IP, DeviceNet, CompoNet and ControlNet. Fig. 1 illustrates a CIP-based protocol. The CIP protocol is a peer-to-peer object oriented protocol that provides

5 connections between the industrial devices, such as sensors and actuators, and higher-level devices, such as controllers. It defines a connection-based scheme that facilitates application communication which can be established by two means: implicit messaging (or I/O connections) which is high priority messaging and provides a special-purpose communication path between the devices; and explicit messaging which is used for

10 generic, multipurpose communication and is a lower priority service. The EtherNet/IP makes use of the standard IEEE 802.3 technology. In this disclosure, the terms “implicit communication data” and “explicit communication data” are used indicating the data transmitted using for example the respective protocol stack as indicated for implicit messaging and explicit messaging as illustrated in Fig. 1, together with the principles

15 demonstrated in this disclosure.

To enable logging of any event in a packaging plant, it is desirable to provide logging rates that correspond to also the fastest update rates of control in the plant. An example of such high-rate equipment is a motion servo axis which for example can have a lowest update rate – course update rate – of 2 ms. By assigning an output port of a

20 PLC towards a bridge node to provide implicit communication data, and to enable a rate of the bridge node corresponding to the fastest rate of provision of the implicit data, e.g. 2 ms, logging of any event is feasible.

Fig. 2 schematically illustrates a packaging machine 200 according to an embodiment. A packaging plant can comprise one or more machines like the packaging

25 machine 200. The packaging machine 200 comprises a plurality of functional units 202 which are arranged to perform operations, e.g. in sequence. The packaging machine 200 can thus become fairly complex and can comprise a unit for cutting packaging material which comes from a packaging material supply, e.g. a roll of packaging material as illustrated at the upper left of Fig. 2. The cutting can include cutting out a piece of

30 packaging material, such as packaging carton suitable for holding liquid content, for one package which then is provided to a package forming unit where the piece of packaging material is formed into at least a part of the package. It should be noted that the illustrated packaging machine is an example, and other types can be equally feasible for the principles set forth in this disclosure. For example, the filling and forming can also

be made simultaneously, the packaging material can be of other types or combinations, the packages can be pre-formed and only be filled and sealed, etc.

The functional units 202 each comprises one or more PLCs for computer control of the packaging machine. Conveyers between machines, material supply mechanisms, supply mechanisms for content to be filled, etc. can also be controlled using one or more PLCs. One or more controller networks 204 connect at least a subset of the PLCs of the plant. Further, one or more entities 206 are connected to the controller network 204 for data collecting logging. Fig. 3 schematically illustrates an example where some PLCs 300 are connected to a controller network 302. The connection of each PLC 300 can be made through two different principles, as indicated above, i.e. through a port for implicit messaging of communication data and/or through a port for explicit messaging of communication data. Control events, e.g. to actuators or other PLCs, which have real-time constraints are provided through implicit messaging to the control network. The implicit communication data can also comprise logging information provided at a port to the controller network addressing a bridge node 304 connected to the controller network. The bridge node can be implemented as a separate entity, but can also be integrated with a data collecting logger 306. The data collecting logger can be a dedicated electronic device with processing, memory and networking capabilities but can also be implemented by using a suitable computer having these capabilities, e.g. a personal computer. A general-purpose computer would then need some adaptations in sense of suitable software and interface circuitry suitable for connecting to the controller network. When using EtherNet/IP and Ethernet, an advantage is that a general-purpose computer many times have Ethernet capabilities, and adaptations can be made through downloading the suitable software.

The bridge node thus interacts with the controller network and thus the PLC or PLCs in a way that fulfils the real-time constraints of the PLC communication for implicit communication data. For example, EtherNet/IP Transport Class 1 protocol can be used. The bridge node can then, e.g. through buffering and/or using other interfaces provide the log data to the data collecting logger in any suitable way. The communication from the bridge node to the data collecting logger need not be time-critical and can be provided through the controller network as explicit data packages, through another network, or by a dedicated line directly to the data collecting logger. The latter is particularly suitable when the bridge node is integrated with the data collecting logger. In that case, the implementation can be regarded as a memory management problem which can be solved by any known solution. The bridge node

may also be locally on the same hardware running the logger, e.g. one personal computer may be the bridge node as well as logger.

The data collecting logger 306 can also be connected to the controller network to exchange explicit data with the PLCs. For example, EtherNet/IP Transport Class 3
5 protocol can be used.

The .NET framework is a part of Common Language Runtime, CLR, which is a common denominator of C++/Common Language Infrastructure, CLI, Visual Basic, .net and C#. CLR is a common base enabling interoperability between different platforms and certain properties and behaviours when it comes to security, expectations
10 and memory management. Applications developed in CLR fall under the category of managed code which is somewhat different from native, or unmanaged, C and C++. The difference is that such code is executed in a runtime execution environment whereby unmanaged code is executed directly from an operating system. Running an application in such an environment has certain advantageous implications for example for memory
15 management. When memory is allocated in native environments, it is up to the programmer to make sure that once the stored data has played out its use, it should be disposed of. The .NET languages have a garbage collection function that frees from having to keep track of memory usage. When the garbage collection function identifies allocated memory that will not be reused by the application, it manages the reallocation
20 or release of memory.

Transition between the two domains of managed and unmanaged, and memory allocated in a runtime environment and memory handled directly in the operating system implies a problem.

The .NET framework allows for three methods of interoperability between
25 native and CLR: Platform invoke, P/Invoke, allows C-style calls to native application programming interfaces, APIs, from managed code; COM interop allows consumption of native COM interfaces from managed code; and C++ Interop allows assemblies comprising mixes of managed and unmanaged code.

C++ Interop is implemented by writing C++/CLI as a mix within the native
30 C++ code. C++ Interop is a powerful interoperability technology which provides more predictable results when transferring information between the two domains. C++ Interop can be implemented using Visual C++ as well as P/Invoke or COM Interop.

When the data has been transferred to C++/CLI, communication is facilitated to .NET languages since both are CLR types where direct function calls are allowed.

A communication protocol can thus be provided with Native C++ running the actual communication. To transfer the data to and from .net, a C++ Interop interface is accessible, wrapping the native code in a dynamic linked library, DLL, where input of IP, MAC, Subnet, and number and size of modules can be input. Once the protocol has
5 been started and communication is established with the PLC, the outputs are transferred from the native code up to the .NET application. Thereafter, inputs can be returned, which are sent to the PLC or can be waited for when there is a next transmission from the PLC.

The nature of the bridge communication protocol allows communication to be
10 set up with multiple PLCs. Each module in the bridge can have an identifier number, e.g. from 0 to 200. If a PLC is defined with a bridge and for example modules 1 to 5, another PLC can be set up with the same bridge but with an identifier starting from for example 6. This enables logging from entire lines of machines in a plant to a single or a few data collecting loggers. For example, a single general-purpose computer can fulfil
15 the task for an entire plant when provided with software as demonstrated above.

Fig. 4 illustrates a method according to an embodiment, performed at a PLC. The method is illustrated as two objects 400, 404, i.e. a first object 400 working on a real-time basis and a second object 404 working without real-time constraints. The real-time object 400 comprises providing implicit communication data, as defined above, to
20 a port of the PLC for provision to a bridge node, and from there to a data collecting logger. The principles for this have been demonstrated above. The other object 404, which may be optional, is illustrated with a flow diagram where a request for explicit communication data is received 405, and upon such request, explicit communication data is provided to the network such that the data collecting logger is enabled to read
25 406 the explicit communication data. Also the principles for this communication are demonstrated above. Thus, according to some embodiments, Ethernet Industrial protocol is employed and the implicit communication data is provided according to the Transport Class 1 protocol and the explicit communication data is provided according to the Transport Class 3 protocol.

Fig. 5 illustrates a method according to an embodiment, performed at an entity
30 interacting with one or more PLCs working according to the method demonstrated with reference to Fig. 4. Thus, the entity can be a data collecting logger or at a bridge node. As a consequence of the method demonstrated with reference to Fig. 4, data can be acquired in two ways. Therefore, the method is illustrated also here as two objects 500,
35 504, where a first object 500 comprises reading implicit communication data and a

second object 504 handles explicit communication data. Here, it can be seen that if the entity comprises the bridge node functionality only, the actions of the first node 500 is what is comprised in the method. For an implementation with integrated bridge node and data collecting logger, both the objects 500, 504 can be comprised in the method, but also in this constellation, the second object 504 should be considered as optional; the functions related to the explicit communication data are not essential for the invention. Each of the objects 500, 504 are illustrated by flow charts for explaining their respective functions.

The first object 500 comprises reading 501 implicit communication data, which is provided for example according to Transport Class 1 protocol according to EtherNet IP through the control network. Optionally, the read data is redistributed 502 using another protocol and over the control network or another network. The another network can include the Internet, which enables remote data logging.

The second object 504 comprises transmitting 505 a request for explicit communication data to a PLC, and receiving 506 explicit communication data as a response thereto. As demonstrated above, this interaction by requesting 505 data and receiving 506 data accordingly does not operate under real-time constraints, and can for example apply Transport Class 3 protocol according to EtherNet IP through the control network.

The methods according to the present invention are suitable for implementation with aid of processing means, such as computers and/or processors, especially since the PLCs, bridge node and data collecting logger inherently are based on processor technology. Therefore, there is provided computer programs, comprising instructions arranged to cause the processing means, processor, or computer to perform the steps of any of the methods according to any of the embodiments described with reference to Figs 4 and 5. The computer programs preferably comprises program code which is stored on a computer readable medium 600, as illustrated in Fig. 6, which can be loaded and executed by a processing means, processor, or computer 602 to cause it to perform the methods, respectively, according to embodiments of the present invention, preferably as any of the embodiments described with reference to Figs 4 and 5. As demonstrated for the methods above, respectively, the computer 602 and computer program product 600 can be arranged to execute the program code sequentially where actions of the any of the methods are performed stepwise, but where real-time constraints demand so, other execution strategies are applied suitable for real-time execution. Such strategies for real-time execution are known in this technical field. The

processing means, processor, or computer 602 is preferably what normally is referred to as an embedded system, at least for the PLCs. Thus, the depicted computer readable medium 600 and computer 602 in Fig. 6 should be construed to be for illustrative purposes only to provide understanding of the principle, and not to be construed as any direct illustration of the elements.

The invention has mainly been described above with reference to a few embodiments. However, as is readily appreciated by a person skilled in the art, other embodiments than the ones disclosed above are equally possible within the scope of the invention, as defined by the appended patent claims.

CLAIMS

1. A mechanism for providing information from computer-controlled packaging plant, wherein at least one portion of the plant is controlled by a first programmable logic controller, PLC, connected to a first controller network, the mechanism comprising at least one output port of the first PLC assigned towards a bridge node of the first controller network, wherein the first PLC is arranged to provide implicit communication data outputs to the output port such that a data collecting logger is enabled to read the implicit communication data through the first controller network and via the bridge node.

2. The mechanism according to claim 1, wherein at least another portion of the plant is controlled by a second PLC connected to a second controller network, the mechanism comprising at least one output port of the second PLC assigned towards a bridge node of the second controller network, wherein the second PLC is arranged to provide implicit communication data outputs to the output port such that the data collecting logger is enabled to read the data through the second controller network and via the bridge node.

3. The mechanism according to claim 2, wherein the first and second controller networks are idem.

4. The mechanism according to any of claims 3, wherein the first and/or second PLC is/are arranged to receive a request for explicit communication data and provide a response to said request by providing a data packet with the explicit communication data on the controller network to the data collecting logger.

5. The mechanism according to claim 4, wherein the explicit communication data outputs to the output port is arranged according to EtherNet Industrial Protocol Transport Class 3.

6. The mechanism according to any of claims 1 to 5, wherein the implicit communication data outputs to the output port is arranged according to EtherNet/IP Transport Class 1.

7. A mechanism for collecting information from computer-controlled packaging plant, wherein at least one portion of the plant is controlled by a programmable logic controller, PLC, connected to a controller network, wherein the mechanism comprises a bridge node which is assigned by at least one output port of the PLC and the PLC is arranged to provide implicit communication data outputs to the output port, and the mechanism comprises a data collecting logger arranged to read the implicit communication data through the controller network via the bridge node.

8. The mechanism according to claim 7, wherein the data collecting logger is connected also to a communication network other than the controller network, wherein the data collecting logger is arranged to redistribute the read implicit communication data through the communication network to a remote computer.

9. The mechanism according to claim 7 or 8, wherein the data collecting logger is arranged to transmit a request for explicit communication data to the PLC and receive a response to said request comprising a data packet with the explicit communication data on the controller network from the PLC.

10. The mechanism according to claim 9, wherein the explicit communication data outputs at the output port is arranged according to EtherNet Industrial Protocol Transport Class 3.

11. The mechanism according to any of claims 7 to 10, wherein the implicit communication data outputs at the output port is arranged according to EtherNet Industrial Protocol Transport Class 1.

12. A computer-controlled packaging plant arrangement, comprising a mechanism for providing information from the computer-controlled packaging plant according to any of claims 1 to 6; and a mechanism for collecting information from the computer-controlled packaging plant according to any of claims 7 to 11.

13. A method for providing information from computer-controlled packaging plant, wherein at least one portion of the plant is controlled by a programmable logic controller, PLC, connected to a first controller network, a mechanism comprising at

least one output port of the PLC assigned towards a bridge node of the first controller network, the method comprising providing, by the PLC, implicit communication data outputs to the output port such that a data collecting logger is enabled to read the implicit communication data through the first controller network and via the bridge node.

14. The method according to claim 13, further comprising of receiving, from the data collecting logger, a request for explicit communication data; and

10 providing, by the PLC, a response to said request by providing a data packet with the explicit communication data on the controller network to the data collecting logger.

15 15. The method according to claim 14, wherein the explicit communication data is arranged according to EtherNet Industrial Protocol Class 3.

16. The method according to any of claims 13 to 15, wherein the implicit communication data outputs to the output port is arranged according to EtherNet Industrial Protocol Class 1.

20 17. A method for collecting information from computer-controlled packaging plant, wherein at least one portion of the plant is controlled by a programmable logic controller, PLC, connected to a controller network, wherein at least one output port of the PLC is assigned towards a bridge node of the controller network and is arranged to provide implicit communication data outputs, the method comprising reading, by a data collecting logger, the implicit communication data through the controller network via the bridge node.

30 18. The method according to claim 17, wherein the data collecting logger is connected also to a communication network other than the controller network, wherein the method further comprises redistributing, by the data collecting logger, the read data through the communication network to a remote computer.

19. The method according to claim 17 or 18, further comprising

transmitting, through the data collecting logger, a request to the PLC for explicit communication data; and

receiving from the PLC, by the data collecting logger, a response to said request comprising a data packet with the explicit communication data on the controller
5 network.

20. A computer program comprising computer-executable program code comprising computer-readable instructions, wherein a processor, upon downloading and executing the program code by the processor, is caused to perform the method
10 according to any of claims 13 to 19.

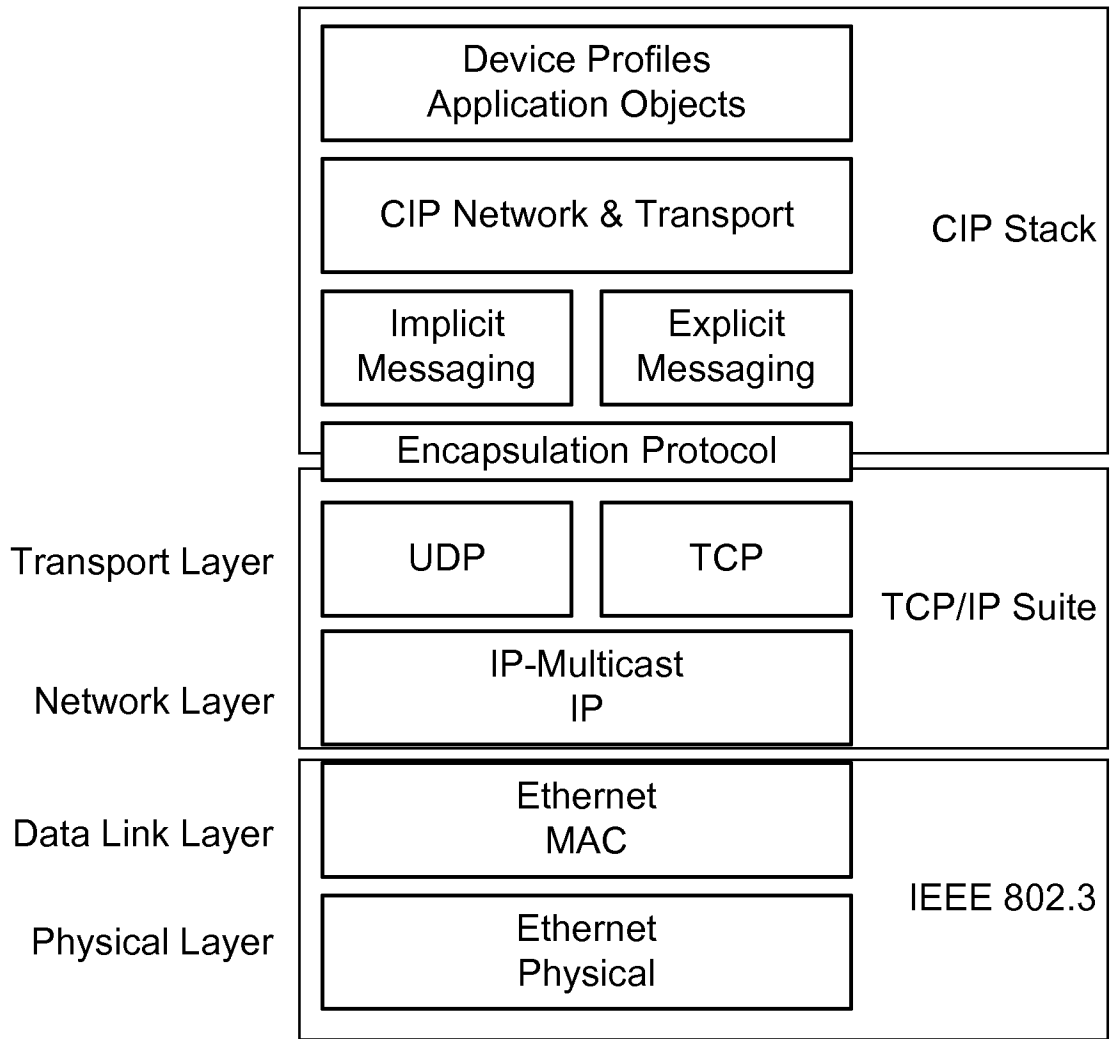


Fig. 1

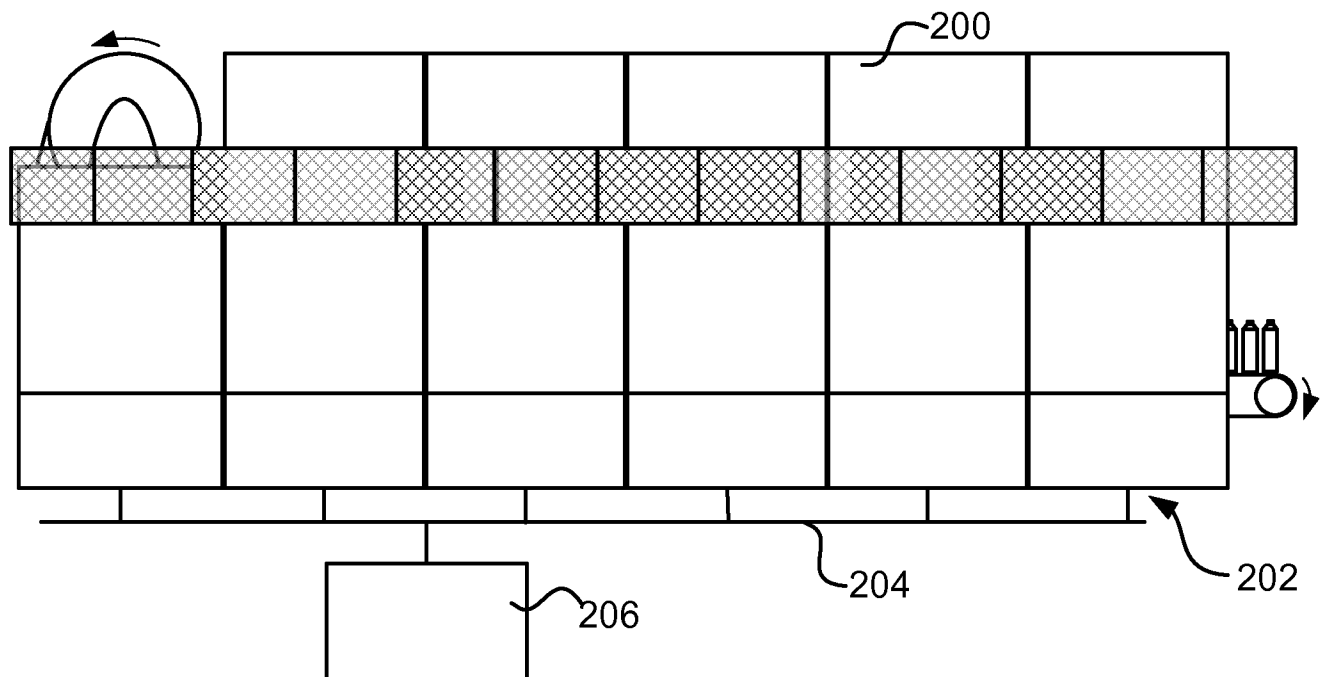


Fig. 2

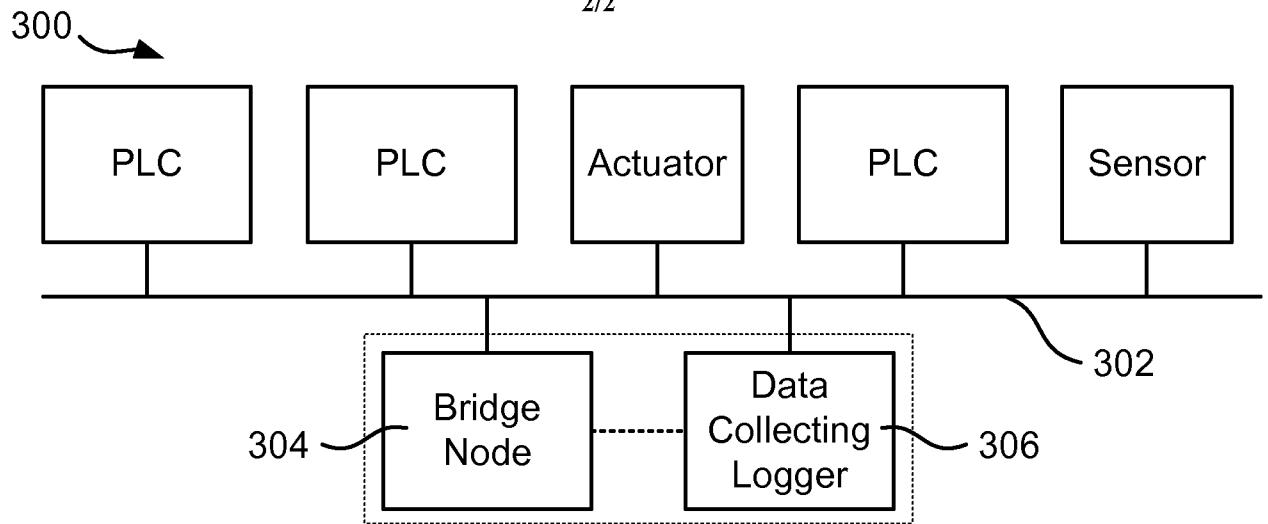


Fig. 3

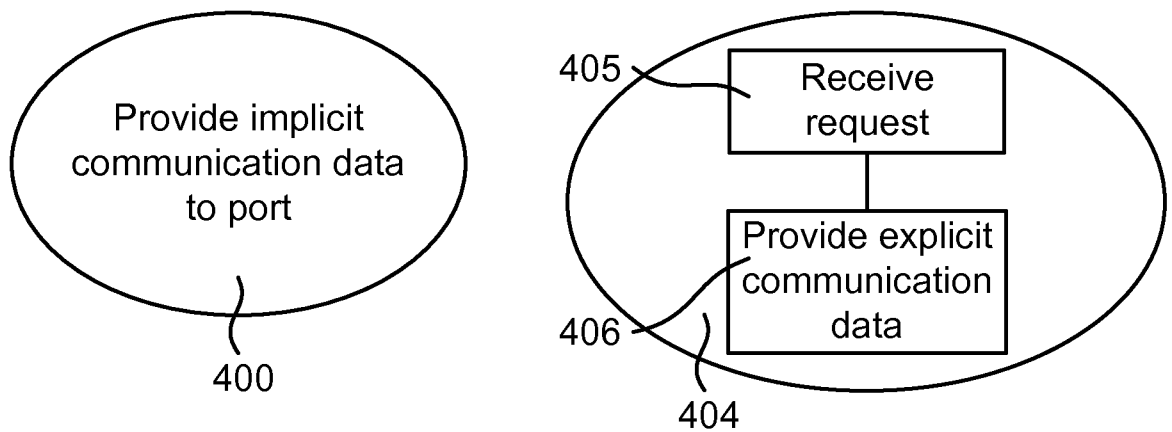


Fig. 4

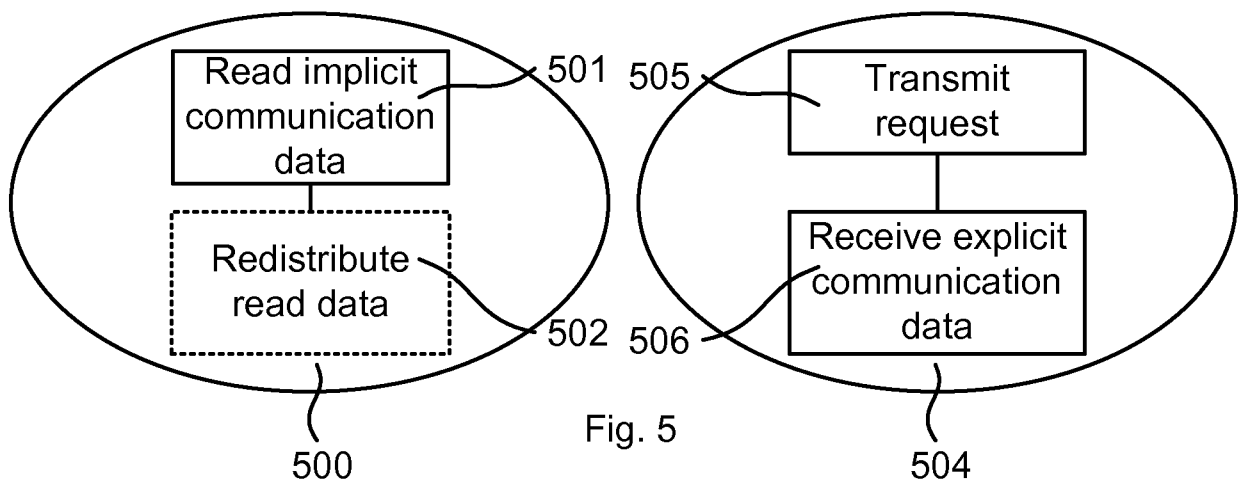


Fig. 5

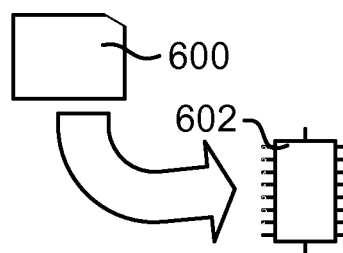


Fig. 6

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2013/076307A. CLASSIFICATION OF SUBJECT MATTER
INV. G05B19/05 G05B19/418
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
G05B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EFTA 2001: "EtherNet/IP: Industrial Protocol White Paper", 1 October 2001 (2001-10-01), October 2001 (2001-10), XP055106212, Internet Retrieved from the Internet: URL: http://literature.rockwellautomation.com/idc/groups/literature/documents/wp/enet-wp001_en-p.pdf [retrieved on 2014-03-07] the whole document ----- -/-	1-20



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Date of the actual completion of the international search

7 March 2014

Date of mailing of the international search report

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INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2013/076307

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	Allen-Bradly: "EtherNet/IP Modules in Logix5000 Control Systems", 1 January 2010 (2010-01-01), pages 1-230, XP055106158, Retrieved from the Internet: URL:http://www.jlab.org/Hall-D/Documents/manuals/Allen-Bradley stuff/EtherNet-IP Modules in Logix5000 Control Systems user manual.pdf [retrieved on 2014-03-07] page 23 - page 33 page 132 - page 215 -----	1-20