Echocollect from Softing Typical Application Examples







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0) Introduction

Process Data Management has become more and more important over the recent years. You need process data for:

- Improving your production output
 - o by condition monitoring (for less downtimes)
 - o by OEE (i.e. Overall Equipment Effectiveness)
- Quality Management: data logging and backup
- Energy Management to save costs on energy

Challenge:

The challenge is to forward the required data from the PLC controllers in the production into your data management applications.

Most of your PLC controllers may already be connected to your ERP or MES system via Ethernet. But...

- ... what about those PLCs which are not connected yet?
- ... what about those legacy systems which are connected via components which have become obsolete in the past (e.g. S5-controllers with CP1430-ISO and AUI cable)?

Softing's Solutions:

Softing can offer you connectivity solutions for almost all types of PLC controllers

- With on-the-fly integration into your existing systems
- Without the need to change existing PLC programs
- With local data storage for highest data safety requirements
- With highest level of IT-security by safe separation of office network and production network

Application Examples:

In the following you will find a selection of application examples showing the large variety of possible solutions for process data collection with *echocollect, echolink* and *echochange*. May be one of these solutions is the perfect one for you?

1) echocollect vs. PC for Data Collection

MES/ERP systems or SCADA require process data from the production. The data normally are available from the PLC controllers in the production. The typical way to get these data from there is to connect the PLC controllers to a server-PC as shown in the drawing below.



Typical Topology for Data Collection via PC:

In this example all controllers are connected via Ethernet to a Server PC. You can do this via controller-specific OPC servers or direct drivers.

From the Server PC the data are forwarded to OPC-clients and a database.

This is in fact the "classic" solution but you may consider following objectives:

- If the PC crashes, all data may get lost
- For each type of PLC the PC needs a specific driver or OPC-Server. This causes a lot of licensing and installation effort if you want to update the PC.
- No separation between office netwok and production network
- In many cases you can only read data from the controllers into a database. Writing from the data base into the controllers is not possible in most cases.

Softing's Solution: Data Collection via echocollect:

As we could see in the example above the weak point is the Server-PC.

All data go through there and all the individual drivers and servers need to be updated and licensed again if you want to replace the PC or to update it to a new operating system (e.g. from XP to Win7).

In this situation *echocollect* from SOFTING is an excellent alternative!

echocollect is a Linux based gateway for collecting data from PLCs via Ethernet or serial connection for direct connection to a database or via the OPC-Pipe server to any OPC-Client. You can mount it to a DIN hat rail in a controller cabinet.

You can connect your controllers to *echocollect* via Ethernet or via their serial programming port. With *echocollect* the topology would look as follows:

Alternate Solution with echocollect:



Benefits:

Compared to a PC solution *echocollect* offers you following benefits:

- Safe operation due to Linux based embedded system
- Data Safety: data are stored on the SD card in *echocollect* and do not get lost if the connection to MES/ERP or the database is down.
- Security: with its 2 Ethernet ports it features a clear separation between office and production network. Your IT-specialists will appreciate this.
- Direct bi-directional connection to database. You also can read data (e.g. recipe) from the database into the PLCs
- Supports most types of PLCs. No hassle with different drivers or OPC-servers. *echocollect* connects to OPC-clients via a multiprotocol OPC-Pipe server

The Siemens S7 controller is one of the most popular PLCs in the world. For exchanging data between S7 and data management applications like MES, ERP or SCADA you will often find a situation as shown in the drawing below:



Typical Scenario with Siemens-S7:

As we can see in the drawing:

- Some of the S7 are connected to MES/ERP via Ethernet-CP from Siemens
- A few others may be connected via MPI/Ethernet gateways like NETLink-PRO-ETH from Softing
- Other S7 or other PLC types are not connected

The Challenge:

- Integration: How to integrate those controllers which are not yet connected to Ethernet? Adding a CP to an old S7 is expensive and requires amending the Step7-programme. If you have got many of these controllers this would cause much effort.
- Data Safety: All data are lost in case of problems with the Server-PC. This also applies to those controllers which are already connected to Ethernet so far.

Softing's Solution: Data Collection via echocollect:

With *echocollect* you can connect your S7 PLCs (and other types) via Ethernet or via their serial programming port (MPI) directly to a database or via the OPC-pipe server of Softing to any OPC-client.

This would look like in the following drawing:

Alternate Solution with echocollect:



Compared to adding an Ethernet-CP it gives you following benefits:

- Data Safety: data are stored on *echocollect* (SD) and do not get lost if connection to MES/ERP or database is down.
- No change of your STEP-7 programmes required. The controller is not touched during the implementation. You can install the connection while the controller is running.
- *echocollect* connects to OPC-clients via a multiprotocol OPC-Pipe server covering S7, S5, AB-CLX, Modbus/TCP, Mitsubishi and others

3) Process Data Collection from Siemens S5



There are still a lot of Siemens-S5 controllers in operation worldwide.

Mostly they still do their job in a very reliable way and it would be a pity to throw them out just for the sake to have something new.

But: often these S5 controllers are not connected to Ethernet or (may be even worse...) they are using obsolete ISO-H1 communication with AUI cables. Integrating these controllers into a modern architecture seemed to be almost impossible until today.

A typical scenario with S5 controllers looks as follows:

Typical Scenario with Siemens-S5:



In this drawing we can see:

- Some of the S5 are connected to MES/ERP via Ethernet-CP. It could be TCP/IP or older ISO-H1 on AUI.
- A few others may be connected via TTY/Ethernet gateways like S5-PCLink from Softing.
- Other S5 or other PLC types are not connected

The challenge:

- Integration: how to implement those controllers which are not connected to Ethernet. Ethernet-CPs are obsolete and would require to amend the Step5-programmes.
- AUI components are obsolete and not supported anymore. AUI and ISO-H1 do not support switched networks.
- All data are lost in case of problems with the Server-PC

Softing's Solution: Data Collection via echocollect:

With *echocollect* you can connect your S5 PLCs via Ethernet or via their serial programming port (TTY). You can write into a database or connect via integrated OPC-pipe to any OPC-Client



Alternate Solution with echocollect:

This solution gives you following benefits:

- Data Safety: data are stored on *echocollect* (SD) and do not get lost if connection to MES/ERP or database is down.
- Integration: No change of your STEP-5 programmes required. This is a major advantage since it causes much effort to change old STEP-5 programmes of older S5-controllers
- With the Ethernet CP "S5-TCP/IP-100" Softing offers a replacement for CP1430. This way you can also handle ISO-H1.
- echocollect connects to OPC-clients via a multiprotocol OPC-Pipe server covering S7, S5, AB-CLX, Modbus/TCP, Mitsubishi and others

S5 Controllers with ISO-H1 with AUI cables:

There are still many S5 controllers using ISO-H1 protocol with AUI cable.

Challenge:

- The Siemens-CPs CP1430-ISO and CP-535 which were using the H1-protocol are obsolete. Siemens does not provide any technical support for them.
- The AUI PC-interface card (ISA) is obsolete as well and due to the ISA bus connector you cannot use it in a modern PC because there is no ISA slot anymore. If any of these components becomes defective you have got a problem.

Alternate Solution with S5-TCP/IP-100 from Softing:

With the S5-TCP/IP-100 Softing offers a replacement for obsolete CP1430 or CP535.

Features:

- Ethernet interface for Simatic S5 (AG 115U, AG 135U/155U, AG 150U)
- Visualisation
- Remote maintenance of S5 via LAN and WAN
- Programming the S5 via LAN and WAN
- Communication with Siemens S7 and S5 PLCs
- Spontaneous data traffic with Fetch on Event
- Communication via Modbus on TCP with PLCs of Schneider, Beckhoff, Wago etc.
- Send / Receive for communication via the Socket interface (raw data)
- Integrated 4 port switch for integration of other field devices
- Pre-configured connections (standard connections) for layer 7 communication (e.g. OPC communication)
- Additional backup on Compact Flash Card
- S5-TCP/IP and S5-TCP/IP-100 are compatible. When upgrading, existing configuration files can be re-used.

If you want to stay with your AUI cables:

S5-TCP/IP-100 connects your legacy S5 to modern TCP/IP Ethernet. But sometimes replacing the existing AUI cable will cause costs. But you can also stay with your existing AUI cable if you use AUI/RJ45 converters. You will find these on the Internet.

Old System

New System







4) Consolidation of Client Requests via echocollect

Quite often systems for process data acquisition have been implemented step by step over the recent years while the production was kept running. This means that you will sometimes find a large variety of applications like SCADA, ERP or other systems which in parallel capture data from the controllers in the production.

Here *echocollect* offers a good solution for consolidating the different communication channels. This way it can help to increase performance and reliability of the PLC controllers.

Recently we had to deal with following scenario at a customer:

Customer Situation before using echocollect:

- There are various PC-based client applications (SCADA, MES, X-1, X-2) which need to get data from PLC controllers (S7, S5, Allen Bradley).
- Only the SCADA has got an OPC-server. The other applications get data directly from the PLCs.
- Each client application gets data from all PLCs independently. For this the customer asked for a solution which avoids that every client is polling the PLCs itself.



Solution with echocollect:

With *echocollect* the system looks as follows:



- *echocollect* is used as a central instance to get data from the PLCs. Preferred connection to the PLCs would be Ethernet, but it could also be done via serial interfaces if a PLC does not have an Ethernet interface.
- *echocollect* stores all received data in an internal flash memory. On demand you can write these data in addition also on a SD card (e.g. once a day). This way data are saved properly and will not get lost.
- echocollect automatically forwards the data to any OPC-client (in our case it is the SCADA). For this you only need a little "OPC-pipe server"-software from Softing on the SCADA-PC which receives the data from echocollect and forwards them to the local OPC-Clients via COM (not DCOM !!) communication. This way you do not need to adjust any DCOM settings which is always a nasty thing.
- At the same time *echocollect* writes the data directly into a data base of your choice (MS-SQL, MySQL, Oracle, dB ..). The client apps (MES, X-1, X-2) can read the data from there and do not need to bother the PLCs anymore. Of course the SCADA system could use this way as well instead of OPC.
 By the way: *echocollect* also can read out data from a database and write into the PLCs.
- In *echocollect* you can define what to do if a data in a PLC is changed. You can trigger on value change, rising edge, falling edge etc. .
 In general you can say that the mechanism is like with an OPC-server. *echocollect* polls for the data in the PLC, the PLC responds and e.g. on value change *echocollect* forwards the data upwards. You can define the poll frequency in *echocollect* individually.

Advantage of echocollect:

- Each PLC communicates only with just one *echocollect*. So the PLC will not be polled from various clients anymore which will result in a significant relief and higher operation safety.
- All data can be stored safely on *echocollect*. This is a good contribution to your data safety.

5) *echocollect* in Systems with different PLC Types

This example demonstrates the advantages of *echocollect* in case that different PLC types are used in a factory.

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Customer Situation before using echocollect:

In this case a customer planned to modernize his telemetry system which so far was looking as follows:

• Data Sources:

Different PLC types: mostly Siemens S7, some Siemens S5, some Mitsubishi-Q and a few Allen Bradley CLX. Most of them were connected via serial-to-Ethernet gateways and some via Ethernet CP.

- Data Targets: Various OPC-Client applications connected to Ethernet
- OPC-Server-PCs:

The data were captured from the PLC controllers by IPCs. On these IPCs different OPCservers were installed (Siemens, Mitsubishi, AB-CLX). There are more than 50 IPCs of this kind in the production



Scenario before using echocollect:

Challenge:

Updating the IPCs to new operating system (e.g. from XP to Win 7) means to the customer for any of the 50 IPCs:

- Updating PC application, new licensing
- Updating and new licensing for all 3 different OPC-servers

Solution with echocollect:

With *echocollect* the system would look as follows:



Advantages of using echocollect:

- *echocollect* replaces the existing serial-to-Ethernet gateways and the IPCs.
- Safe data storage on *echocollect* (SD card).
- Safe separation between office network and production network.
- No PLC programming required.
- No need anymore for various OPC-servers on IPCs, no hassle with licensing in case of SW updates. All OPC-data are handled by Softing's multiprotocol OPC-pipe.
- Configuration of *echocollect* can be stored on SD card. This makes a replacement very easy.

6) Siemens S7 as central Data Collection PLC

The previous examples focused on solutions for getting data from the PLC controllers into data bases or PC applications. But sometimes customers prefer to collect data via a central Data Collection PLC (e.g. a S7-400) and to forward the data from there to the database or the PC applications.

In this case we need to establish PLC to PLC connections in order to get all data into the Data Collection PLC.

Customer Scenario:

- Central Data collection PLC: S7-400
- A number of S7-300 connected to Ethernet with CP-343-1
- A number of S5-PLCs connected to Ethernet with CP1430-TCP and some with CP1430-ISO
- A number of CLX and Modicon controls connected via Ethernet
- A number of various PLCs without Ethernet connection
- All different kinds of PLCs need to communicate with the central Data Collection PLC for data capturing.

Softing's Solution:

- 1) All S7 with Ethernet-CP and all S5 with CP1430-TCP can be connected directly via Ethernet to the Data Collection PLC
- 2) echochange from Softing: This is a PLC-to-PLC-gateway for direct PLC-PLC communication between most typical PLC types like Siemens, CLX, Modicon, Q etc.... In our case that means that the Data Collection PLC polls echochange (put/get).

echochange then collects data from other PLCs on Ethernet and forwards the data in S7-format to the Data Collection PLC.

The connections are as follows:

- All S5 with CP1430-ISO (or older CP535) need to be connected to RJ45 cables via AUI/RJ45 adapter (e.g. <u>www.inee.pl</u>). Once connected to modern Ethernet they are connected to *echochange* from Softing.
- All other PLCs with Ethernet connection are connected to *echochange* as well.
- All other PLCs without Ethernet CP are connected to *echolink* from Softing.
 echolink is a gateway for connecting PLCs via their serial programming port to Ethernet. From *echolink* the data are forwarded to *echochange* and from there in S7-format to the Data Collection PLC.

More info on *echochange*:

 $\label{eq:http://industrial.softing.com/en/products/functionality/plc-connectivity/protocol-converter-horizontal/ethernet-to-ethernet-converter-for-several-protocols/echochange-ethernet-gateway.html \end{tabular}$

More info on *echolink*:

http://industrial.softing.com/en/products/functionality/plc-connectivity/protocol-converter-horizontal/echolink/multiple-serial-to-ethernet-converter-echolink.html

System Topology:



Conclusion:

- With *echochange* you can connect most common PLCs via Ethernet to a Siemens S7
- With *echolink* you can connect most common PLCs via their serial port to Ethernet
- With the combination of both types you can achieve almost any possible constellation.

7) Worldwide data collection in remote database



Scenario:

An automotive supplier with more than 30 production facilities worldwide needs to track all production data for central analysis to increase production and improve quality management. For this production data shall be collected in local databases in each individual plant worldwide and from there transferred into a remote database at the central location using SAP

Challenge:

- Get data of several types of PLCs without any change of PLC program from all concerning production facilities worldwide into an existing data base system
- The required gateway need to be located in the local switchboard
- Data backup locally with time stamps on the gateway in case of network problems

Solution with echocollect:

Flexible and scalable system for fully automatic data collection/storage/analysis



Benefits:

- Only with echocollect they can assure the required data throughput from the lines to the database. Existing solutions with OPC-servers increasingly create problems in case of high data rates. Then time stamps get wrong, local storage overflow occurs in case of weak connections to database. With echo they do not have these problems .
- Echocollect offers one standardized solution for all different types of PLCs and machines. Therefore the implementation in every individual plant is identical and can be done easily by following a standardized and predefined procedure.
- Any machine with a PLC can be connected to central database
- Verified data are transferred automatically via SAP
- Real time logging for production batches (like OK/failure bookings, statistics, etc.) Faster breakdown repair by remote access to the machines:
 - *before:* On machine breakdowns maintenance people had to go to the machine, connect laptop at machine and see what the problem is
 - now: by mouse-click in his office the maintenance engineer sees what the problem is -> faster breakdown repair, improved (software-)maintenance
- Automatic real-time reporting based on the logged data is now possible
 - before: time delays and high effort for report making, only aggregated figures once per week, error-prone (manual calculation of manually collected figures)
 - now: production report delivered daily, real-time, automatic, detailed information about plant/department/shift/day/week,... on one click or automatically based on the production data delivered by echocollect into central data base system
- based on automatic production figures and inventory change data the amount of scrap can be calculated automatically
- OEE: Automatic breakdown detection for all machines
 - before: manual inputs of organizational breakdown (begin, -end, -reason) causes high manual effort, is inexact, error-prone, etc.
 - now: each organizational breakdown is set up exactly and fully automatically identified

Conclusion:

- optimal real-time production planning (production scheduling) with a good performance is now possible
- Increase in production because of less breakdowns or planned maintenance
- Less scrap and a continuous production is the key for good quality
- With cycle-time tracking the continuity will increase
- Exact data for a more effective and efficient scrap reduction process
- Elimination of hundreds of thousands manual bookings and pieces of paper per year
- Transparency (better inventory data, faster decisions of management based on exact data, shorter repair times, less effort for maintenance, etc.)
- Less manpower, less failures, no time delays



Production plant (in this case food and beverage) with different types of PLCs in different machines needs to communicate to each other

But: no standardized interface for process data is available for the different plant components



Existing PLC data interfaces are not compatible to each other due different I/O item standard.

Challenge:

- Data exchange between different types of PLCs is needed.
- No changes on PLC programs allowed by plant manufacturer due warranty issues.

Solution with echocollect:

- Define standardized I/O table in echocollect to realize a standardized data exchange between different PLCs in different plant components
- Echocollect acts as a standard interface for process data between machine and plant components



I/O-Item table

Benefits:

- Standardized communication between different PLCs using defined I/O-item table
- No PLC programming required
- Echocollect will handle the complete communication actively (read from one side and write to the other side)
- No restriction to only one "master" PLC for the process handling

Conclusion:

• Process improvement in production process due standardized data exchange between different plant components using different PLC types

9) Direct link between PLC and SAP system



Scenario:

Process data from the production field need to be available in IT environment especially in SAP system.

Solution with echocollect:



Benefits:

- Echocollect offers a direct connection between SAP and plant PLCs without additional PC hardware via Ethernet.
- Integrated OPC tunnel connection in echocollect avoid complex DCOM configuration.
- SAP PCo module works as an OPC-client and get access to several PLC vendors supported by echocollect.
- The included 2 network interface cards in echocollect enables a physically separation between plant network and IT network

Conclusion:

- Fast and easy connection from SAP into plant network to get out data via a defined and password protected access
- No need for extra PC hardware and operating system maintenance or additional software i.e. OPC-Server

10) OPC UA gateway



Scenario:

An Existing PLC system needs to be connected to new OPC UA technology.

Challenge:

New MES/ERP systems or SCADA supports OPC UA only or the new IT guideline specifies OPC UA as a communication standard.

All existing PLC systems need to achieve the new standard.

Solution with echocollect:



Benefits:

- Echocollect provides OPC UA server interface embedded for OPC UA client connection
- PLC vendor specific communication down to the PLCs via a wide range of serial protocols: MPI, PPI, AS 511, RK512, 3964R, DF1, Modbus RTU, IPC-620, NITP, PSG, DCU, SattConn Comli, Koyo, Telnet / ASCII and Ethernet protocols like TCP/IP, RFC1006 (ISO on TCP), ISO (H1), EtherNet/IP, AB Ethernet, S5, S7, CLX, SLC, Send / Receive (Raw Data / Socket), TCP/IP with PLC Header, Modbus on TCP, Melsec-Q, DLMS, DCU

Conclusion:

• Easy integration of existing PLC systems without any changes into new UA environment.

11) Siemens S7 link to Ethernet/IP and Modbus TCP

Scenario:

Siemens S7 PLCs are designed to communicate to other Siemens controller using Siemens Industrial Ethernet protocol.

A direct PLC to PLC communication to other vendors like Rockwell Allen Bradley using Ethernet/IP is not supported.

Solution with echocollect:



Benefits:

- Siemens S7 PLC use Siemens standard communication (RFC1006 with PUT and GET functions) to communicate to other PLCs linked via echochange in the same network
- Echochange will convert the Siemens S7 command into the specific communication protocol (i.e. Ethernet/IP or Modbus TCP) that is needed to communicate to the target PLC (i.e. Allen Bradley ControlLogix or Schneider Modicon)
- From the S7 PLC point of view the target PLC will act like another Siemens PLC

Conclusion:

• Echochange will enable Siemens S7 PLCs to communicate to other PLC vendors using its own Siemens Industrial Ethernet protocol.

12) Visualization of Process and Manufacturing Data

Scenario: Standalone PLCs or isolated applications needs to be equipped with small SCADA or HMI locally



Solution with echograph:

Benefits:

- Live data visualization via a powerful graphical HMI based on native web technology
- Data can be displayed and modified in a web browser without interference to existing controller systems
- Based on scalable, resolution-independent vector graphics, the data can be consistently displayed on a wide variety of network enabled devices, e.g. desktop PC, laptop, smart phone, tablet PC or an industrial control panel
- Direct link to Ethernet addressable controllers like Siemens Simatic S7 and S5, Rockwell ControlLogix and CompactLogix, Rockwell PLC-5, Rockwell SLC-500, Controllers with Modbus/TCP (Wago, Beckhoff, Phoenix, Schneider, etc.), Mitsubishi (Melsec-Q), etc.
- Import of variables directly from a STEP7 project
- freely configurable data logging to an SD card, which enables data retention for subsequent analysis

Conclusion:

• Echograph visualizes and controls PLCs via ordinary web browsers by its integrated web server using atvise webMI Visualization