OPC UA and Direct Database Data Exchange Modules for ControlLogix®
Topics

► Data Transfer Methods
► Direct Database – tManager Module
► OPC UA – OPC UA Server Module
► Softing Info
Need to move data between ControlLogix and a database or OPC client?
You could do it this way…

Data Transfer via VB Script; Custom Code or Transaction Management Software

Business System (Database or OPC client)  Programming or Scripting Expertise  Office or Industrial Computer or HMI  Operating System & Data Transfer or Scripting Software  PAC/PLC System (Controller)  Plant floor Controller Expertise

Ethernet for data transfer

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Or use an eATM module…

Business System (Database or OPC client)

Ethernet for data transfer

Data Transfer via Softing eATM Module

PAC/PLC System

Softing tManager or OPC UA Server

Plant floor Controller Expertise

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Points to Consider When Choosing an Approach to Transfer Data

► Architecture
- Would you prefer the data transfer be running in a module or in a computer?
- Do you have a single or multi-vendor installation?
- How many sources and recipients of data?
- What are your local data storage needs? (e.g. buffering, logging)
- Is it desired/required that switchover (failover) to other databases be available should the primary connection fail?

► Cost/Budgeting
- How is budgeting/funding arranged between plant floor control systems and higher level information systems?
- What is the budget? Will there be funds available for future support, maintenance and updates?
Points to Consider When Choosing an Approach to Transfer Data

► Security
  - How will your system security be affected?
  - Would software updates and patches be an issue?
  - Viruses/Malware concerns
  - Do you need to control access to the data or the system configuration?
  - How is the data sent? (e.g. certificates, encryption)

► Support/Maintenance
  - Who will set up the initial data transfer solution? Who will maintain it?
  - How often will the data transfer configuration be changed?
  - What is the relationship between IT and the plant floor?
Why use eATM modules?

► Physically integrated in ControlLogix chassis
  ─ Plant floor maintainable
  ─ Industrialized packaging

► Dedicated hardware solution
  ─ No PLC code modification
  ─ No code development or management
  ─ Data exchange is configured via straightforward mapping with a drag and drop GUI
  ─ Data exchange handled by the module

► Secure
  ─ No need to deal with O/S upgrades, patches or viruses
  ─ Setup/maintenance access only via GUI

Reduce installation and maintenance costs
eATM® Enterprise Appliance Transaction Modules

- An alternative to software running on separate computers
- Available for two types of data handling
  - tManager® for complete end-to-end data handling
  - OPC UA Server for OPC UA Client/Server systems
OPC UA Client/Server vs Direct Database with tManager

► tManager systems are typically part of MRP/MES systems
  - Direct database inserts of production data
  - Execution of stored procedures for recipe downloads

► OPC UA systems are SCADA-like
  - Client-Server architecture
  - Typical data transfer speeds are 1 second and slower
Topics

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tManager “Configure & Go” Data Transfer

Computer Adapters

Database
- Microsoft SQL
- Oracle
- MySQL
- Excel/Access
- IBM DB2
  - AS400
  - System i

Messaging
- Red Hat Jboss JMS
- IBM WAS JMS

Communication
- TCP/UDP
- FTP
- Bi-Directional Email

Add to New or Existing Systems
- Maps /Triggers
- Store & Forward
- Failover
- Audit and Transaction Logs

Controllers

Rockwell Automation
- ControlLogix ®
- CompactLogix
- PLC-5 ®
- MicroLogix

Schneider Quantum

Siemens S7-300 or S7-400

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tManager Overview
Configurable Elements

Automatically Found
- Database Tables
- PLC Tags

What You Define/Configure
- Message Paths
- Maps
- Triggers
- Endpoints

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Couldn’t I use a Historian?
Transaction versus Historian Data

**Transactional (Relational Data)**
- Bidirectional (data is exchanged)
- There is a record with reference data about every transaction (e.g. time and date, recipe, batch, shift, order number, equipment used, etc.) – could be complex data structures

**Historian (Time Series Data)**
- Unidirectional (data collection)
- Relatively simple data (pressure, temperature, etc.) recorded very fast

There is room for both in a good plant data model but this presentation will focus on transactional data exchange
Definitions: Transactional Data

Examples of transactional data usage:

– Instructions/recipes
  • Process to order
  • Assemble to order (e.g. Dell computers)
  • Build to order (e.g. aircraft)

– Measure & Monitoring
  • Product/material tracking and tracing
  • Equipment health
  • Overall equipment effectiveness (OEE)
  • Events and alarms

Transactional data is time stamped, has numerical values and is associated with one or more objects
Transaction Data Example: Instructions Download

Downloading of Instructions
- Control system triggers a transaction
- A stored procedure in the database downloads data to the control system.

Stored Procedure Example:
1. Barcode scanner reads pallet ID and control system sets a value
2. Execution of the stored procedure is initiated by CLX value change
3. Stored procedure "looks up" pallet information to decide what needs to be loaded
4. Stored procedure values are mapped to the controller
5. Controller tells palletizer what to load
Transactional Data Example: Database Insert

- **Overview**
  - Transaction triggered by a value in the control system, an event, or a combination of both
  - Data collected from the control system is inserted in the database
  - Database acknowledges the insert
  - Completion defined when all data is transferred and receipt acknowledged

- **Product Count**
- **New Work Order**
- **Set time or interval**
- **Change in Value or Schedule**
- **Defined Data Map**
- **Transaction**
- **Write Data**
- **Confirmation**
- **INSERT Data**
- **Production Line**
- **Database** (e.g. MSSQL)
Benefits:
Faster Implementation

▶ The tManager enumerates controller & database tags/structures
▶ Easy configuration via graphical user interface
  – Define path to controller(s)
  – Define path to database or message queue
  – Map data sources to data destinations
  – Setup triggers
  – Place into run
▶ Functoids - provide tag manipulation without the need to modify PLC code
▶ Copy/Paste & Search/Replace reduce configuration time
▶ Entire User-Defined Data Types (UDTs) can be mapped to a database XML column as one item to optimize communication
Benefits: Robust Data Handling & Auditing

► Once configured, all data transfers are handled by the module itself – no other software is required
► SQL code can be shared with IT to aid in start-up troubleshooting
► Data Buffering and Destination Failover
  – Store & Forward: If communication is lost, data can be stored on the tManager
  – Failover: on loss of communication to the database, messages can be transferred to/from an alternate destination
► Logs and Notifications
  – System events, user changes and transaction monitoring via user configurable logging
  – Configurable email alerts for transactions failures, loss of connectivity, server interruptions and other errors
  – Email Notification adapter included with every tManager
Store & Forward

- Data will be written to the tManager’s CompactFlash if communication is interrupted, and written to the original destination once communication is resumed.
- Optional email notification.
Failover

- Can specify alternate database(s) or messaging endpoint(s) that data is sent to/read from when the original destination/source is not available
- Optional automatic recovery attempt
Benefits:
Security and Traceability

► No open computer/operating system - virus resistant
► Access for configuration only though the tManager GUI
  – Granular user privileges
► 2 electrically isolated Ethernet ports
  – 1 for enterprise network
  – 1 for configuration/control network
► Audit logging
Benefits:
Straightforward Maintenance

► Flexible and easy-to-implement spare part options
► Configuration is stored in a single backup file
  – Restore file to spare CompactFlash or module
► No restrictions on loading GUI software on multiple PCs
► Extensive help
  – Context sensitive online help
  – Knowledgebase (http://kb.oldi.com)
  – Service Requests
  – Live support sessions via WebEx
**tManager: Turbine Blade Heat Treatment**

*The challenge:*
Upgrade a system that uses MS-SQL for recipe download and production data upload, and includes a mix of PLC families. Replace VB scripting with faster more robust approach.
tManager: Turbine Blade Heat Treatment

Solution:
New ControlLogix with ENBT and tManager modules
- Fast access to existing PLCs
- tManager configured to handle recipe downloads and process data uploads

Continued use of entire legacy PLC system
tManager: Turbine Blade Heat Treatment

Results:

- Faster data exchange between MS-SQL database and legacy PLCs. Decreased data transmission time to under 100ms per exchange vs ~20 seconds.
- Increased manufacturing throughput by 16%
- Reduced time to configure by 75%
- Payback in days
tManager: Automotive Track & Trace
Tier 1 Engine Casting

Aluminium → Melting → Casting
Resins & Sands → Cores → Sand Recycling
Casting → Finishing → Quality Control
Sand Recycling → Birth Certificate → Storage → Storage → Storage
Finished Product

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tManager: Automotive Track & Trace
Finishing Line - Plant 2 (Before)

The challenge

- Implement track and trace process
- Integrate 5 isolated production lines
- Connect to legacy controllers
- Replace VB scripting
- Buffer data in case of lost wireless communications

Isolated lines with no connectivity among controllers and no upload to the enterprise
**Solution**

- Add 3 ControlLogix systems as data concentrators/gateways
- Use tManager modules to transfer data to and from Enterprise Server

**Results**

- Fast data exchange between MS-SQL and PLCs, faster than customer expectations
- Ability to have another tManager module available for quick disaster recovery and reuse at multiple locations
- Customer confident in validity of transactions due to handshaking and error messaging from tManager module

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**tManager support for RA bridge modules simplifies connection to older PLC systems**
Topics

- Data Transfer Methods
- Direct Database – tManager Module
- OPC UA – OPC UA Server Module
- Softing Info
What is OPC?

Originally: OPC = **OLE for Process Control**

**OLE = Object Linking and Embedding**

*OLE is a proprietary technology developed by Microsoft that allows you to take objects from a document in one application and place them in another.*
What is OPC?

► First released in 1996

► OPC provides a common interface for communications between different products from different vendors.

► The OPC Foundation defined a set of standard interfaces that allow any client to access any OPC compatible device using a protocol now referred to as OPC Classic.
What is OPC?

- OPC provides standard specifications for Data Access (DA), Historical Data Access (HDA), and Alarms and Events (AE).
- Uses: visualization and control, data collecting, data exchange.
- Common applications: access to PLC data, integration into IT and industrial applications, building automation.
OPC Classic Limitations

► Based on Microsoft COM/DCOM technology
  - Limited to MS Windows
  - Complicated configuration for remote client-server connections
  - No intrinsic security - setting up DCOM security is error prone and vulnerable to operating system updates and patches
  - Microsoft has de-emphasized COM/DCOM in favor of cross-platform capable Web Services and SOA (Service Oriented Architecture)

► Not scalable

► Specifications are not integrated
OPC UA

► OPC UA = Open Connectivity Unified Architecture
► Released in 2008
► Main goal: keep all the functionality of OPC Classic, while switching from Microsoft COM/DCOM technology to a cross-platform Service Oriented Architecture
OPC UA: Platform Independence

- Mac
  - Java Client
- Windows 7
  - .NET Client
- Linux
  - C/C++ Client
- Linux
  - Java Server
- Windows XP Embedded
  - .NET Server
- VxWorks
  - C/C++ Server
OPC UA: Scalability

The full functionality of the OPC UA specification is chunked into profiles describing subsets of the full feature set.

OPC UA components can be scaled in functional support, complexity and footprint.
OPC UA: Seamless and Secure Communications

- Use of web services allows connections over a VPN and through firewalls
- Built-in security provides authentication and encryption capabilities to protect data
OPC UA: Unifies all Specifications

...versus the separate OPC Classic specifications
OPC UA summary

► OPC Unified Architecture (UA) is the latest OPC standard created for industrial applications by the OPC foundation.

► OPC UA combines existing standards, OPC DA, OPC AE, and OPC HDA, into a Service Oriented Architecture (SOA) which is platform independent.

► For more information on OPC UA, visit the OPC Foundation website (https://opcfoundation.org/about/opc-technologies/opc-ua/) . The latest version of the OPC UA Specification can also be downloaded from their website: (https://opcfoundation.org/developer-tools/specifications-unified-architecture/)
Configuring an OPC UA system

Server
- Configure to access tags from the PLC. Tags may be marked as read-only or writeable, or they can be hidden.
- Configure security settings.

Client application
- Client will connect to server using security settings.
- Reading: “Subscribe” to the values that it wishes to receive
- Writing: Any tags can be selected from the list posted by the server

Server
- Once the Client application has “subscribed” to a tag, the server will provide its value.
- Support Read/Write requests from the Client
OPC UA Client/Server Architecture with Computer-Based Server

- Enterprise/Business/Plant System
- Enterprise Network
- Main PAC/PLC (Data Concentrator)
- Other PACs/PLCs
- Data transfer Software/Hardware
- OPC UA Client
  - Operating System (various for OPC UA)
  - Database
  - Custom Application
- OPC UA Server
  - Operating System (various for OPC UA)
  - PLCs & Other Devices

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OPC UA Client/Server Architecture with Softing OPC UA Server Module for CLX

Enterprise/Business/Plant System

Enterprise Network

Main PAC/PLC (Data Concentrator)

Other PACs/PLCs

Data transfer
Software/Hardware

OPC UA Client (third-party)

Operating System (various for OPC UA)

Softing OPC UA Server ControlLogix Module

- Database
- Custom Application

- PLCs & Other Devices
OPC UA: Connecting to RA Integrated Architecture®

► Rockwell Automation provides products which are OPC DA 2.05 compliant. (OPC Classic)
  – However, RA has no OPC UA connectivity

► RA has worked with encompass partners to provide OPC UA connectivity to the Integrated Architecture®.

► Softing as an Encompass Partner provides:
  – The 56eATM® (Enterprise Appliance Transaction Module) OPC UA Server Module, which fits in the ControlLogix chassis.
Softing & OPC

► OPC Foundation founding member
  - Part of the Classic and UA specifications working group
  - Softing OPC UA code is the reference code for the Foundation

► OPC Foundation active working groups
  - TAC Technical Advisory Council
  - UA Specification Group
  - Software Management Group
  - OPC Europe Steering Committee
  - OPC for Devices
The 56eATM® (Enterprise Appliance Transaction Module) OPC UA Server Module, fits in the chassis and communicates via the ControlLogix backplane and/or or by EtherNet/IP.

The module is configured via a graphical user interface (GUI).

Fully certified for OPC UA compliance by the OPC Foundation.

Specifications:
- Standard UA Server Profile (6.5.47)
- OPC UA client-server communications security
- OPC UA client compatibility for scalar tags, UDT component tags & arrays
- Complex Type Facet ControlLogix UDT Support (6.5.11)
Connecting an OPC UA Client to Logix PAC/PLCs

OPC Client

56eATM OPC UA Server Module for ControlLogix

OPC UA

EtherNet/IP via bridge module to ControlLogix or CompactLogix or other RA PLCs
Appliance Configuration – Client Authentication

Configuring OPC UA Client Authentication and Security Policy
Appliance Configuration – PLC

Defining path to controller and enumerating tag list(s)
Browse Tag List
Configure Tag Writeable
The OPC UA Client: Configuring Server Access
The OPC Client: Browsing Server Address Space
Topics

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For over 35 years, the core business of Softing Industrial Automation has been industrial data communication with products ranging from chips & stacks up to dedicated gateways and data transfer modules.

Softing acquired Psiber Data GmbH and OLDI in 2014. Psiber Data sells cable testing products. OLDI is an Original Design Manufacturer (ODM) that designs and sells PAC/PLC modules. OLDI as a company continues as an ODM.

OLDI branded and Psiber Data products will transition to the Softing brand in 2016.

As of January 1, 2015, the official North America company name is Softing Inc.
► Global Encompass Product Partner
► Products for Rockwell Authorized Distributors:
  • Data Exchange Modules
  • Communication and Protocol Modules
  • Network Monitoring and Cable Test Tools
► Headquartered in Knoxville, TN
Products for the Rockwell Automation Channel

- Move Data
- Connect Networks
- Run Custom Programs
- Qualify Cabling
- Certify Cabling