

ICCP IMPLEMENTATION FOR DISTRIBUTED CONTROL SYSTEMS

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ABSTRACT

Inter-Control Center Protocol (ICCP) has typically been provided as a data connection method between SCADA Energy Management System (EMS) control centers. This paper reviews implementations of ICCP for the Public Service Company of New Mexico (PNM), which provides communications between generating plants using Distributed Control Systems (DCS) and a central Energy Management System (EMS).

SYSTEM ARCHITECTURE

Existing Installation

In the past, PNM has utilized different types of interfaces for data exchange between the central Energy Management System (EMS) and the generating facilities. These existing interfaces consisted of:

- An RTU style interface at San Juan Units #1 and #2 using a legacy SCADA RTU and hard-wired AI/AO and DI/DO interfaces
- An ASCII link interface using 30 year-old proprietary technology at San Juan Units #3 and #4.

The existing interfaces were used for Automatic Generation Control (AGC) Operation, enabling the transfer of data such as Gross Generation, Operating Limits (High/Low/Ramp Rate), Maximum Operating Capacity, Unit Online Status, Unit AGC Status, Net Generation, and Requested Target Load values.

Although the existing interfaces had been operating satisfactorily, the existing installation was at risk due to:

- Obsolescence of RTU hardware: The RTU AI/AO DI/DO interface at San Juan Units #1 and #2 was a legacy unit with limited spare parts and no expansion capability.
- Obsolescence of data modems for ASCII interface: In this case, the modems for the ASCII interface were obsolete and could not be replaced because the software took advantage of quirks specific to that particular brand of modem. Failure of a modem would have caused the link to be unusable. The interface was also slow (20 second update on data), limiting its usefulness.

New Requirements

Two new generating facilities required additional interfaces for AGC control. These new facilities included:

- GE Turbine Controls at Lordsburg, a new twin 40 MW gas turbine facility
- Foxboro I/A Series DCS System at Afton site, a new 135 MW gas turbine facility

PNM determined that a new approach was required to replace the existing interfaces, and to accommodate the new facilities. The key factors in determining the requirements for the new interface included:

- Replacing older technology with current technology already in use at the PNM EMS Power Operations Center
- Standardizing on a single interface across all systems
- Using only off-the-shelf software for which the manufacturer committed long-term support
- Utilizing new TCP/IP based links over fiber, using existing Microwave links for backup
- Improving the performance of data interfaces (i.e. faster transfer of data)

Although PNM had a proprietary protocol available for performing AGC, it had been developed several decades ago. Newer, more standardized techniques had become available.

Selection of ICCP as the desired protocol was an early, easy choice -- not many alternatives existed. But the dilemma still remained that there were no 'off-the-shelf' implementations, only libraries. The use of such libraries would have required PNM to build a custom solution to deploy ICCP.

In 2002, Invensys and LiveData, Inc. teamed to offer a more integrated approach to ICCP and real-time data integration. Invensys introduced ilccp, utilizing LiveData RTI (Real-Time Integration) software. This paved the way for PNM to deploy ICCP in a standardized fashion across all of the DCS systems utilized by the generating plants

What is ICCP – and why use it?

Utilities throughout the world specify the Inter-Control Center Communications Protocol (ICCP) to provide data exchange between utility control centers, utilities, power pools, regional control centers, and non-utility generators. ICCP is also an international standard: International Electrotechnical Commission (IEC) Telecontrol Application Service Element 2 (TASE.2).

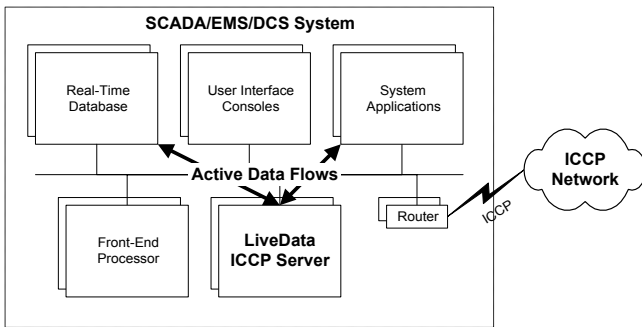
ICCP operates across LANs and WANs to enable the exchange of real-time and historical power system monitoring and control data, including measured values, scheduling data, energy accounting data, and operator messages. Data exchange can occur between and among: multiple control center EMS systems; EMS and power plant DCS

systems; EMS and distribution SCADA systems; EMS and other utility systems; and EMS/SCADA and substations.

LiveData Implementation

The LiveData RTI (Real-Time Integration) software enables data to flow bi-directionally across diverse systems and protocols. The LiveData Protocol Server provides a robust ICCP server solution, as well as support for both industry-standard protocols (OPC, IEC61850, DNP3 and MultiSpeak) and proprietary protocols (such as Modbus, ModbusPlus, PG&E and Allen-Bradley).

The LiveData Protocol Server runs in one or more stand-alone processors and provides a fully functional ICCP link with the ICCP network. It communicates with the SCADA/EMS/DCS real-time database and system applications via built-in server interfaces.



LiveData ICCP system components and data flows.

LiveData uses on-line object configuration to minimize the cost and complexity of developing and maintaining ICCP. LiveData also allows incremental, on-line configuration of ICCP links with other systems. This, coupled with LiveData's high level of integration with the Windows user interface, makes LiveData ICCP easy to manage and administer, and hence was chosen by Invensys as the preferred ICCP gateway interface.

Invensys I/A DCS Implementation

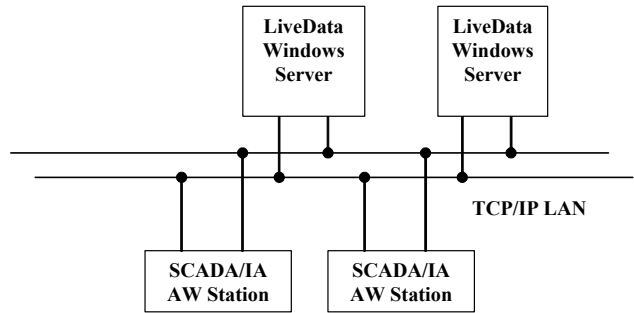
The Foxboro I/A Series DCS implementation uses a bundled product developed by Invensys called ilccp. This product provides ICCP functionality for various Invensys systems, including:

- Foxboro I/A Series DCS Systems
- Foxboro I/A Series SCADA Systems
- Invensys Wonderware Systems

For Foxboro I/A DCS Systems, the product is installed to an Application Workstation (AW). The ilccp product provides for access to any I/A Compound:Block.Parameter data in the DCS system for bi-directional transfer through the LiveData Protocol Server.

The ilccp product is coupled with a Windows based LiveData Protocol Server on a local area network (LAN), shared with the DCS system (i.e. a TCP/IP high speed connection). The Windows server typically uses Microsoft Windows 2000, 2003, or XP Professional as the operating system

A simplified network and hardware configuration is shown below:



Typical ilccp Configuration

To simplify the creation and maintenance of data sets (i.e. bi-directional transfer of data), the ilccp suite includes a graphical configuration tool that provides mapping from the I/A DCS Compound:Block.parameter control database to the ICCP database. Using this tool, the user can quickly assign any information in the DCS system to be transferred to the remote ICCP interface, at what frequency, and in what direction.

ICCP Point Configuration

ICCP Point Configuration

	Attr/Para	Data Type	Direction	Index	Rate	ICCPName
B	default	DIGITAL	Local->ICCP	3001	10SEC	AD_AW1_AMP_13_B
B	default	DIGITAL	N/A	2002	10SEC	AD_AW1_MVAR_13_B
B		ANALOG	^ N/A		N/A	
iL		ANALOG	^ Local->ICCP		N/A	
B		ANALOG	^ ICCP->Local		N/A	
B		ANALOG	N/A		N/A	

ilccp Point Configuration Utility

Full redundancy of the interfaces is supported through the ilccp package. In this configuration, multiple AW workstations are used as the interface to multiple LiveData Protocol Servers. The redundancy scheme is implemented seamlessly by providing automatic failover to backup servers, upon the loss of connection to the primary server.

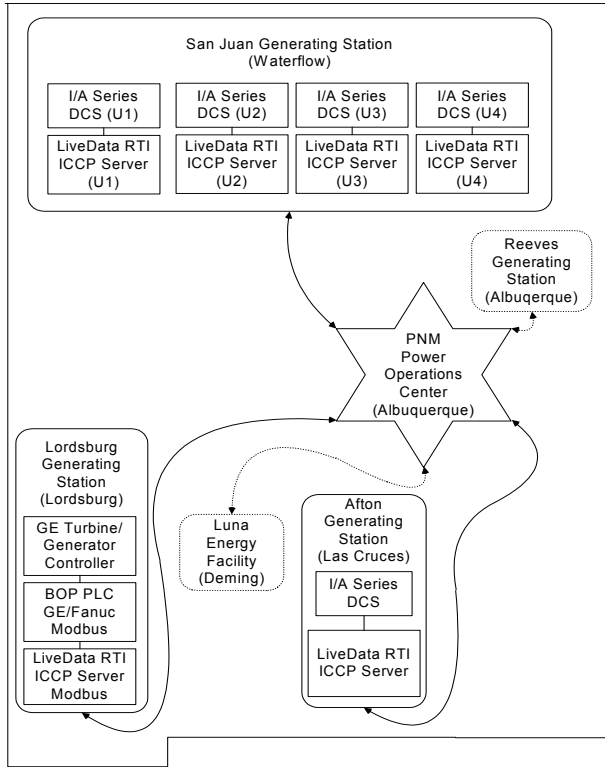
A key feature of the ilccp package is the transfer of data quality as well as data through the interface. Using the quality data from the ICCP link, the EMS SCADA Control Center can detect loss of data through any of the interfaces or the loss of a single transducer input and avoid incorrect AGC control decisions. The existing I/ADCS quality is mapped to the equivalent ICCP data quality during the data transfers.

The ilccp package uses the local non-network Foxboro Application Program Interface (API) for data transfer in and out of the I/A Series DCS System.

IMPLEMENTATION

New Configuration

The existing interfaces at San Juan and the new interfaces were implemented entirely using LiveData RTI software along with the Invensys ilccp product for Afton and San Juan Units 1-4.



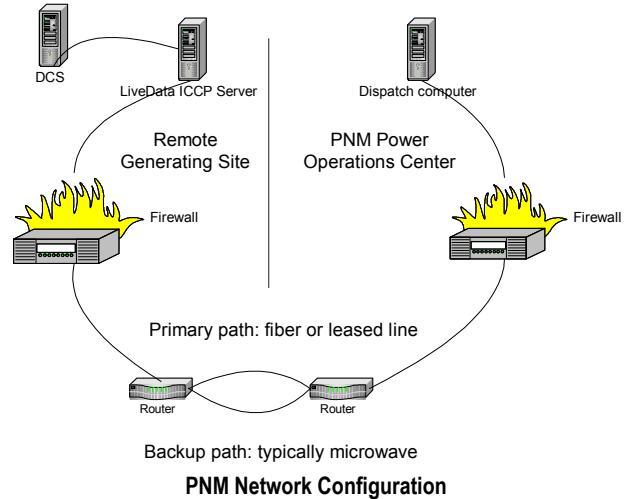
ICOP Interfaces for PNM Generating Units

The Lordsburg Generating Station does not utilize a Foxboro I/A Series DCS system. At this site, the LiveData Protocol Server was connected via Modbus to a GE Fanuc PLC that provides the Balance Of Plant (BOP) functionality as well as interfacing to the GE Turbine Control system. This configuration provides the required basic interface and has worked well, but does not include the configuration tools or quality propagation inherent in the ilccp package.

Physical Network

The dedicated physical network linking the various sites includes a new fiber optic network and a backup Microwave system. The network carries TCP/IP connectivity, which is used for the ICCP connections.

The fiber connection is a 100 Mb local area network.



Roll-out

Implementation of each interface started with the ICCP association agreement. This agreement defines the raw interface description, including server addressing and network interface description. The actual data to be transferred was agreed upon through the exchange of data descriptions on Excel spreadsheets.

The implementation of ICCP began with the initial project at the Lordsburg site, as a turnkey contract with Invensys. LiveData provided on-site installation and support. Macros were introduced on the Lordsburg site in the LiveData protocol server to overcome implementation details between Power Operations and the Lordsburg site.

Implementation of the Afton site was done by installing the ilccp package on the application workstation, and installing a LiveData Protocol Server running on Windows NT. This interface was done in conjunction with site visit from Invensys personnel to set up the interface.

Implementation of the units at the San Juan sites was performed by the customer, as they felt comfortable with the installation process. Phone support was provided as required to install the interface on the Windows 2000 Server systems, and also to install and configure the ilccp package.

Configuration of the interfaces (i.e. data sets, transfer rates, etc.) is maintained by the customer.

BENEFITS

The following benefits have been realized through the installation of the ICCP interface:

- The installation and maintenance of the ICCP interfaces is reduced to a “cookbook” approach; only configuration is required to install and update the interface
- The ICCP interface provides much higher performance than the previous interfaces (i.e. RTU and ASCII link)
- Obsolete hardware has been replaced with commercial off-the-shelf, PC-style servers and software
- All systems are standardized on the interface and can be maintained with a smaller staff
- The interface is “off-the-shelf” with no custom modifications for PNM, offering better long-term support
- The interface can be easily extended in the future to accommodate new operating requirements

FUTURE DIRECTIONS

As the interface for ICCP is standardized and software is implemented across all systems, concepts are being presented to enhance the coordination between the SCADA/AGC system and the Generating Plants for better coordination and scheduling. Enhancements under review include:

- *Throttle Pressure:* Include in the data set the throttle pressure of the generating unit. This would enable the Operations Center to determine if a generating unit is ready to go online. Currently, if the unit is offline, the operator at the Operations center does not have visibility into pressure values, and so cannot gauge a generator’s readiness to make power.
- *Number of Mills:* The number of mills operating could be useful information to the SCADA/EMS operator. If multiple mills are unavailable, the generating unit cannot run full load, so there is no reason to anticipate that full load can be dispatched to that particular generating unit.
- *Linux Migration:* The LiveData ICCP function can be moved from Windows NT/2000 to the Linux Operating System, reducing vulnerabilities of a Windows based operating system and extending the breadth of potential hardware platforms.

These and other items will be reviewed once the Power Operations Center completes other planned upgrades of the central SCADA/EMS system.

Possible future ICCP deployments for PNM are in the planning stages and may include:

- *Connection to Reeves Generating Station*, a three unit 160MW natural gas steam turbine facility in Albuquerque
- *Future connection to Luna Energy Facility*, a new 570MW Combined Cycle natural gas plant near Deming, NM to be completed in 2006

SUMMARY

The inclusion of ICCP on all of the operating PNM Generating Units has provided a consistent and maintainable interface. These interfaces are included in the Power Operations Center ICCP scheme and provide the interfaces for AGC control.

The adoption of a common real-time data communications scheme using ICCP was accomplished through the use of industry-standard interfaces, without requiring any custom programming. These interfaces have proven themselves to be very reliable in the three years of operation.

Use of the industry-standard interface provides reliable system operation with fast data transfer, as well as the flexibility to accommodate future requirements.

ABOUT PUBLIC SERVICE COMPANY OF NEW MEXICO

PNM serves 405,000 electric customers and 459,000 natural gas customers in about 100 communities statewide and also sells electricity on the wholesale market. The company, New Mexico’s largest electricity and natural gas provider, is based in Albuquerque and has offices in more than 20 cities.

PNM was founded in 1917 as the Albuquerque Gas and Electric Co. and has undergone several transformations, including name changes, during its history.

ABOUT INVENSYS PROCESS SYSTEMS

Process Systems, a business unit of Invensys plc, provides products, services, and solutions for the automation and optimization of industrial processes, power plants, and power delivery operations. Invensys Process Systems includes industry-leading brands such as Foxboro, Triconex, SimSci-Esscor, Wonderware, and Avantis, whose products are installed in more than 100,000 installations across the world.

The Invensys Group (www.invensys.com) is headquartered in the UK and listed on the London Stock Exchange. With 35,000 employees operating in 60 countries, Invensys helps customers to improve their performance and profitability, building value for end users and shareholders alike

ABOUT LIVEDATA, INC.

LiveData, Inc. (www.livedata.com) is a leading innovator of real-time data management solutions for the utility and energy services industries.

LiveData RTI (Real-Time Integration) software spans diverse protocols and applications to capture, deliver, graphically present and archive real-time data, and to enable real-time response for mission critical operations.

Founded in 1991, LiveData is headquartered in Cambridge, Massachusetts.