ORACLE

Oracle Utilities Live Energy Connect ICCP Solution

Minimize code development with a configuration-driven ICCP solution

January 2021, Version 2.0

Public

Table of contents

List of images

List of tables

Executive Summary

Inter-Control Center Communications protocol (ICCP) is the de facto standard worldwide for control-center communication in the electric power sector, enabling data exchange inside utility systems as well as between utilities and power pools, regional transmission organizations (RTOs), independent system operators (ISOs) and non-utility generators. Oracle Utilities Live Energy Connect (Oracle Utilities LEC) is operational technology (OT) middleware which can function as a standalone ICCP server or can enable the easy addition of ICCP capabilities to new and existing SCADA, EMS, and DCS systems. The Oracle Utilities LEC ICCP solution provides an ideal way to manage data flows to other utility applications, such as outage management systems (OMS) and substation automation.

Oracle Utilities LEC is a software solution that runs on cost-effective hardware platforms to provide an ICCP communications processor for new or existing SCADA/EMS/DCS/DERMS systems. As a Windows application, Oracle Utilities Live Energy Connect can run on a large range of hardware from gateway PCs to high-end servers. Oracle Utilities LEC's high level of integration with the Windows user interface results in an ICCP solution that is easy to manage and administer.

Oracle Utilities LEC is designed for easy integration by original equipment manufacturers, value-added resellers, system integrators, and utility engineering staff. Oracle Utilities LEC features a rich set of integration methods that can be easily applied to new and existing SCADA systems. These integration methods include REST, messaging protocols, SCADA protocols, file sharing, MMS, and database access for popular database products.

Oracle Utilities LEC is the first ICCP solution that uses an object configuration-driven approach to minimize the cost and complexity of developing and maintaining ICCP interfaces. As a result, it enables the creation of the most highly maintainable, flexible ICCP system possible. Our engineers played a significant role in the development of ICCP per IEC 60870-6 and in the development of "Secure ICCP" per IEC TS 62351-4.

Key Benefits

Use Oracle Utilities Live Energy Connect ICCP to

- Deploy the fastest time to value, lowest risk solution of any OT integration platform
- Ensure consistent transactions with operational and trading systems
- Establish a reliable ISO/RTO integration
- Participate in ISO/RTO coordination meetings
- Apply unsurpassed industry knowledge and ISO/ RTO experience to every implementation
- Safeguard stable communications and reduce the risk of any transmission downtime

Be confident with a proven track record of providing on-time delivery and long-term support for ISO/RTO integrations

"Oracle's Live Energy Connect platform and professional services team delivered a production-ready solution in less than a week under pressure of a fixed deadline, saving SmartCloud and our energy aggregator clients time and money."

Michael Barnett, Ph.D.
EVP, SmartCloud, Inc.

Oracle Utilities LEC – Your Single Source for ICCP Connectivity

Unlike other vendors you might consider, we own and understand every line of code you will be depending on for your ICCP solution. Our engineers developed our own ICCP solution from the transport layer up, including our MMS and ACSE implementations. This means that, as an Oracle Utilities customer, you will receive the highest level of support and responsiveness. And, you will never be dependent on third or fourth parties to resolve any problem that you might have.

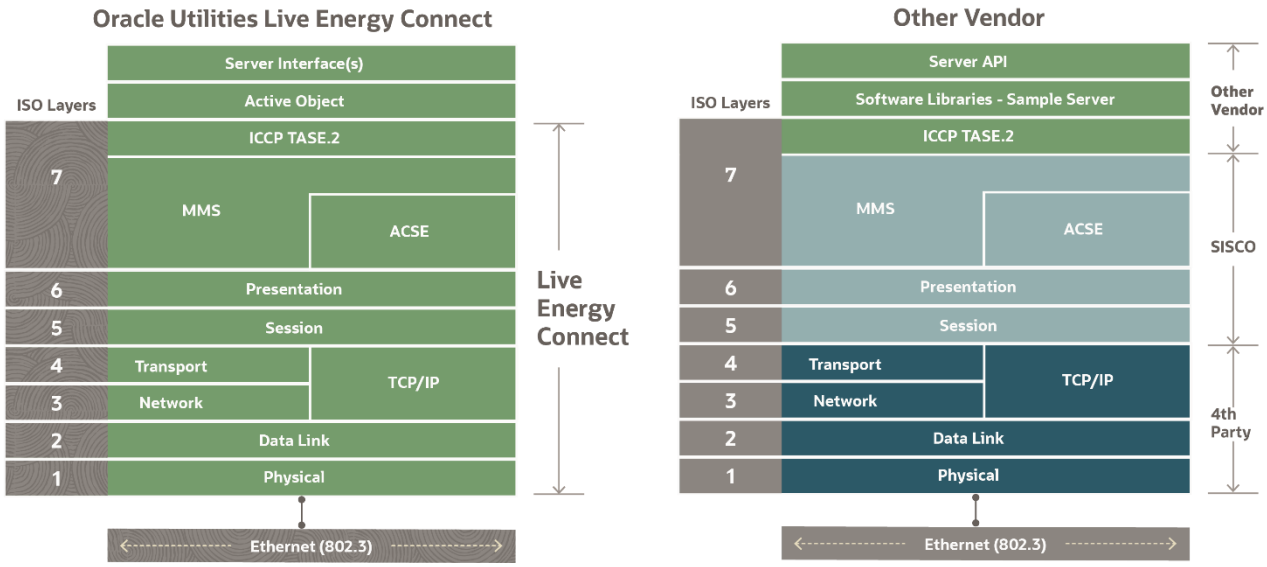

Image 1. A comparison of Oracle Utilities' ICCP implementation to other vendors' ICCP implementations

Proven Server Application

Oracle Utilities LEC provides a complete communications data path from the incoming ICCP connection to your system. With Oracle Utilities LEC you benefit from a proven robust application rather than having to build a custom C/C++ program from a set of function libraries. Critical features required for reliable communications such as connection management, fault tolerance, redundant network support, no memory leaks, and on-line configuration are already built into the Oracle Utilities LEC application and are proven in mission critical applications at customer sites including 13 of the top 20 investor-owned utilities (IOUs). As a result, your ICCP solution is assured of getting implemented faster and running more reliably.

With Oracle Utilities LEC you benefit from a proven robust application rather than having to build a custom C program from a set of function libraries.

An Overview of ICCP

The Inter-Control Center Communications Protocol (ICCP) is used by utility organizations and software vendors throughout the world to provide data exchange over wide area networks (WANs) between utility control centers, utilities, power pools, regional control centers, and non-utility generators. The ICCP standard is maintained by the International Electrotechnical Commission as IEC 60870 and is also known as International Electrotechnical Commission (IEC) Telecontrol Application Service Element 2 (TASE.2). A certificate-based secure implementation of ICCP (and other MMS-based protocols) referred to in the industry as "Secure ICCP" is defined in the IEC TS 62351-4 technical specification. Oracle Utilities Live Energy Connect can easily be configured to use Secure ICCP, providing your organization and partners with a secure, reliable, and authenticated ICCP association.

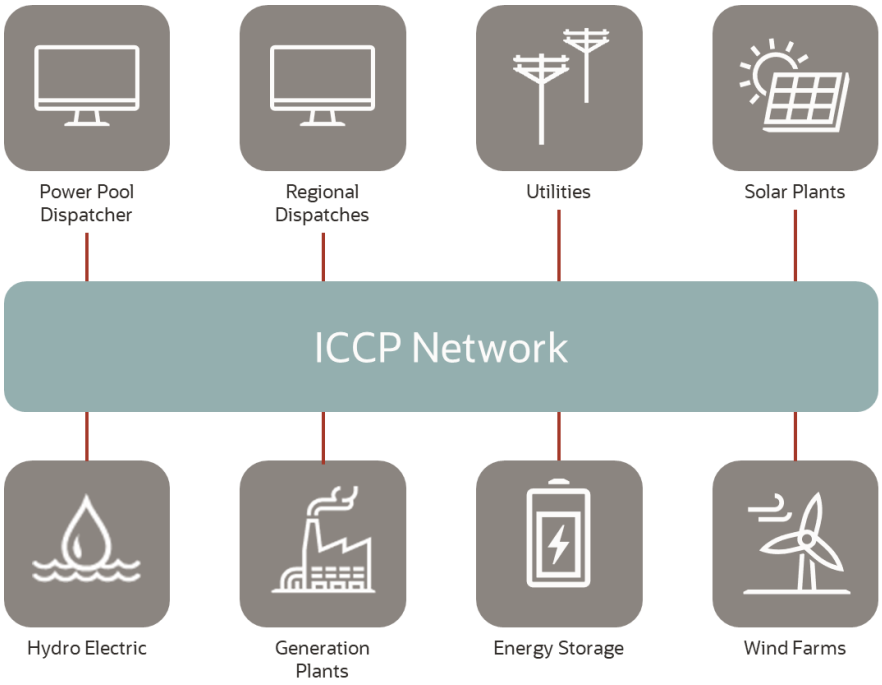

Image 2. A typical ICCP power pool network

Retrieve Historical, Time Series Data

ICCP allows the exchange of real-time and historical power system monitoring and control data. This includes measured values, scheduling data, energy accounting data, and operator messages. Data exchange can occur between: 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. Image 3 shows a typical ICCP configuration.

ICCP allows the exchange of real-time and historical power system monitoring and control data.

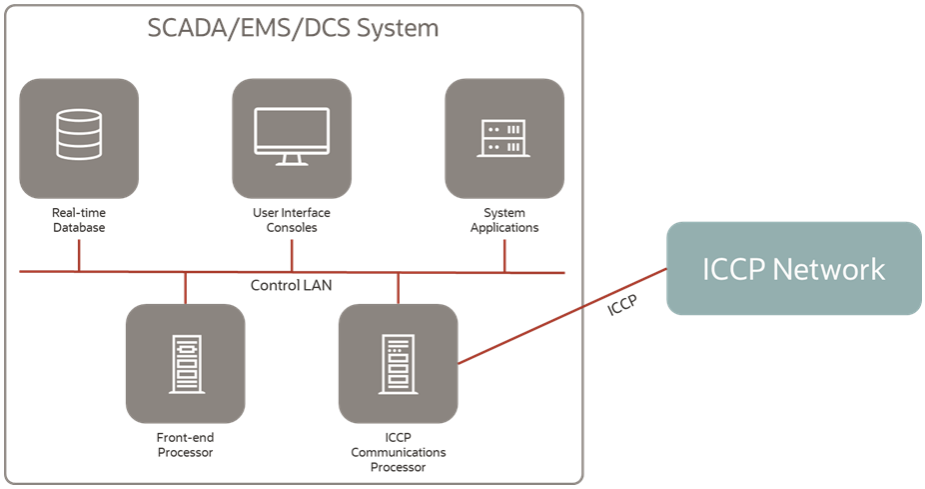

Image 3. A typical ICCP system configuration

Oracle Utilities LEC as an ICCP Server

Oracle Utilities LEC is designed for easy integration with SCADA systems by OEMs, system integrators, and end users. Image 4 shows Oracle Utilities LEC, along with other system components and data flows. Oracle Utilities LEC runs in one or more standalone processors and provides a fully functional ICCP link with the ICCP network. It communicates with the SCADA real-time database and system applications via built-in server interfaces, described on page 7.

Oracle Utilities LEC is designed for easy integration with SCADA/EMS/DERMS/DCS systems by OEMs, system integrators, and end users.

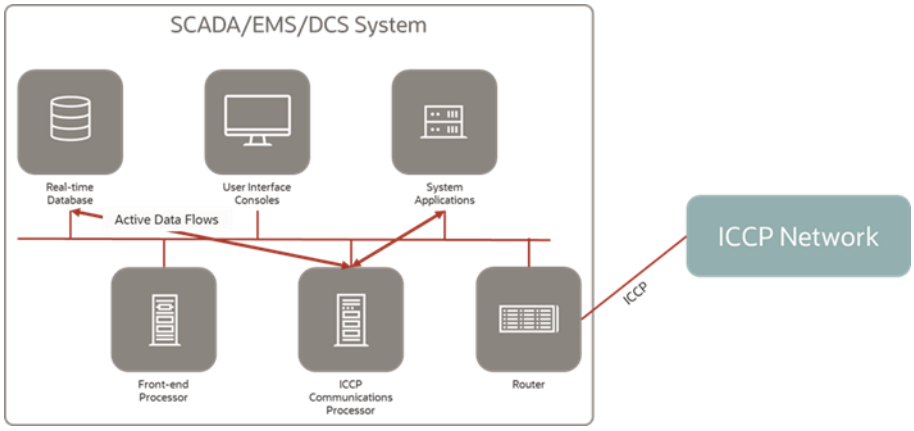

Image 4. Oracle Utilities LEC system components and data flows

Oracle Utilities LEC is the first ICCP tool that uses on-line object configuration to minimize the cost and complexity of developing and maintaining ICCP applications. Oracle Utilities allows for incremental, on-line configuration of ICCP links with other systems. Oracle Utilities uses a codeless programming approach in which configurable real-time objects eliminate the need to write C/C++ code on the ICCP server and minimize the integration code required on the EMS/SCADA system. As a result, Oracle Utilities LEC is the most highly maintainable, flexible ICCP solution available today.

Oracle Utilities LEC features built-in support for redundant ICCP communications processors. Redundant network paths are supported intrinsically by Oracle Utilities LEC's software architecture. Redundant Oracle Utilities LEC servers can

be configured to provide a "hot standby" design in which communication continues without disruption when a failure occurs. Alternatively, they can be configured to provide automatic failover recovery from complete or partial failures.

Architecture

ICCP was originally specified for the integration of a 7-layer protocol stack with EMS/SCADA system applications. All the ICCP objects and system-specific objects required for ICCP communication are implemented in the Oracle Utilities LEC solution. Image 5 shows how Oracle Utilities LEC implements the ICCP layers and integrates with SCADA systems. Oracle Utilities LEC can communicate with SCADA systems using several built-in server interfaces.

Oracle Utilities LEC limits the customization and integration required to connect a SCADA system to an ICCP peer or other application by virtualizing interfaces as Virtual Manufacturing Devices (VMD's).

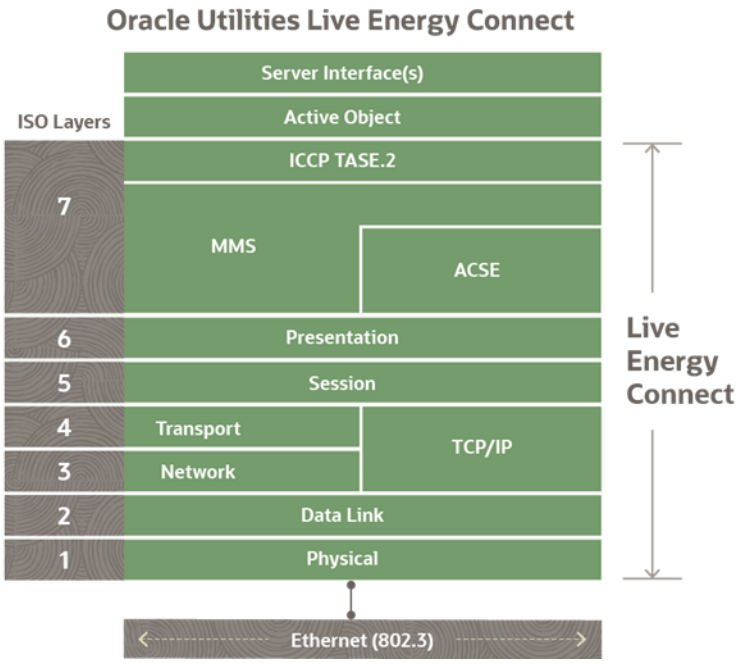

Image 5. Oracle Utilities LEC server integration architecture

Oracle Utilities LEC includes a rich set of built-in server interfaces that enable the rapid development of a communication link to your system.

Built-In Server Interfaces

Oracle Utilities LEC includes a rich set of built-in server interfaces that enable the rapid development of a communication link to your system. These interfaces are designed to support the easy integration of new and existing SCADA/EMS/DCS/DERMS systems by OEMs, system integrators, and end users. You can select from most major utility protocols like: Modbus TCP/IP, DNP 3.0, OPC UA, SQL, and more. Many integrations also use REST and message bus protocols. Once you select a server interface and integrate it with your system, the Oracle Utilities application allows configuration of all ICCP-specific operations and functions. Defining data flow is executed graphically and

configurations are synchronized programmatically by changing JSON or CSV files.

ICCP Object Configuration and Management

Oracle Utilities LEC implements ICCP communications by dynamically creating a configuration of memory-resident system Virtual Devices that implement the data flows and interaction rules of ICCP. For each remote ICCP peer, Oracle Utilities creates an ICCP Virtual Control Center (VCC). VCCs contain only the ICCP objects that are to be shared with the peer control system (as specified by the ICCP concept of bilateral tables). Since each bilateral relationship is managed as a separate VCC, peer communications are highly secure and easily manageable.

Oracle Utilities LEC offers a configuration driven ICCP solution that minimizes code development.

System Virtual Device

The System Virtual Device provides access to SCADA systems via a built-in server interface. The System Virtual Device contains one active object for each point in the real-time database.

Bilateral Table Object

One Oracle Utilities "VCC" virtual device represents each bilateral table. Active objects capture bilateral table attributes and map ICCP data values to points in SCADA/EMS systems. VCCs control data flows to and from SCADA/EMS/DCS systems.

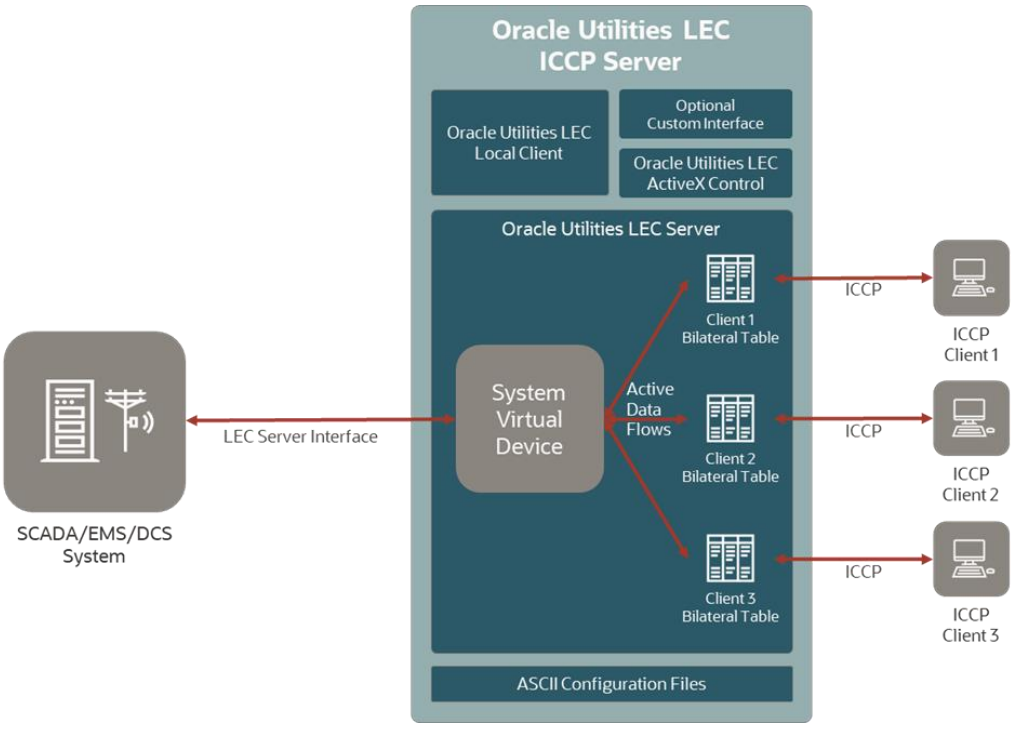

Image 6. Oracle Utilities LEC Software Architecture

On-Line Configuration and Management

Oracle Utilities is the first ICCP server that allows on-line object configuration. This eliminates the need to write code to create, add, or modify bilateral tables or data points. The Oracle Utility LEC Server is on-line configurable using the local Oracle Utilities LEC Configuration Manager (which is included in the Oracle Utilities LEC software package). New VCC's can be created and populated with objects without shutting the server down. Oracle Utilities LEC saves its server configurations in database files and restores itself from these files on startup.

The benefit of this configuration-driven approach is that it allows on-line management of your ICCP solution and rapid response to changes. You can modify bilateral tables or add new ICCP partners without affecting any other ICCP nodes. You can add, start, stop, and modify ICCP links with the system on-line. Similarly, you can add, remove, or modify SCADA points without shutting the server down. This unique capability allows rapid response to changes in SCADA systems or ICCP bilateral agreements.

Oracle Utilities LEC allows on-line management of your ICCP solution and rapid response to changes.

Off-Line Configuration

Working off-line, or in Batch Mode, you can generate prototype configurations and batch files that Oracle Utilities LEC loads will load on startup. Oracle Utilities LEC saves the current configuration at shutdown and restores it at startup.

Custom Interfaces

You can also develop an on-line configuration interface of your own. For this, you can leverage the local Oracle Utilities Client to develop a Windows interface tailored to your system. Oracle Utilities Client supports your choice of Python 3 scripting, C++, Microsoft's Dynamic Data Exchange, Microsoft's Object Linking and Embedding (OLE) via Oracle Utilities' ActiveX Control, and Oracle Utilities' C API interfaces.

Networks and Platforms

As shown in Image 7 below, Oracle Utilities LEC typically runs on a dedicated machine (Windows Server 2016 or Windows Server 2019) and acts as a communications processor for your system. Oracle Utilities LEC is purposely designed as a separate communications processor that can be easily integrated with EMS/SCADA systems running on other software platforms. It supports redundant configurations with hot, warm, or cold backup. It communicates with your system using your choice of standard Oracle Utilities LEC interfaces. It communicates with remote ICCP nodes via Ethernet using standard routers to frame relay, X.25, or other physical WAN environments.

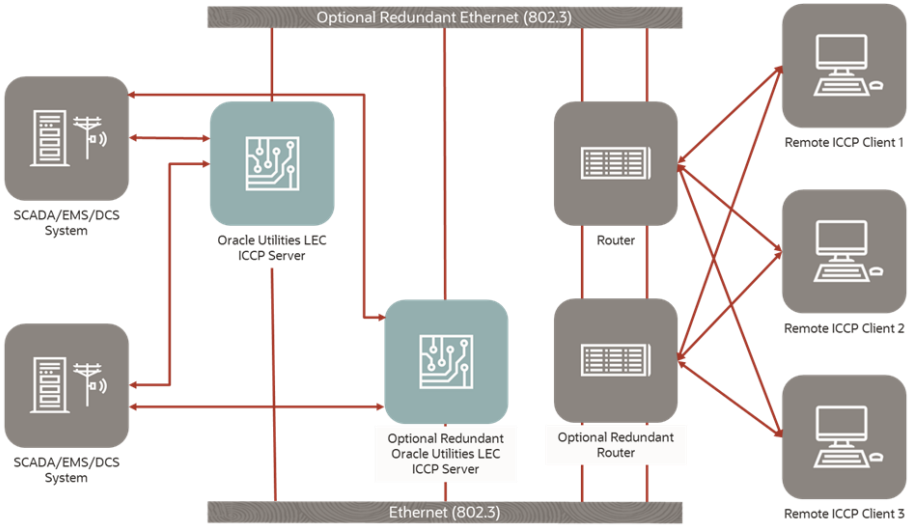

Image 7. Oracle Utilities LEC supports fully redundant system architectures

The Oracle Utilities LEC Platform

Oracle's smart grid data and intelligence solutions for utility companies enable confident, real-time management of power grid assets for

- Critical infrastructure network segmentation and protection
- Independent system operator (ISO) / Regional transmission organization (RTO) connectivity
- SCADA and OMS real-time state monitoring, control, and communication
- Demand response aggregation
- Visualization
- Data analytics

Be Assured with Proven Reliability

Oracle Utilities Live Energy Connect ICCP Solution is backed by Oracle and supported by experienced, OT-savvy professional services engineers who provide a quick path to getting your solution online. Oracle Utilities Live Energy Connect platform offers a suite of high-availability solutions and services for the utilities industry.

The Oracle Utilities LEC Platform

Oracle's smart grid data and intelligence solutions for utility companies enable confident, real-time management of power grid assets for

- Critical infrastructure network segmentation and protection
- Independent system operator (ISO) connectivity
- SCADA, OMS, and DMS real-time state monitoring, control, and communication
- Demand response aggregation
- Visualization
- Data analytics

Appendix A: ICCP Conformance

Table A-1. Oracle Utilities ICCP Conformance Block Support

ICCP implementations specify their conformance to the ICCP specification in terms of "building blocks." For each block, conformance is specified in terms of client, server, or both. Oracle Utilities LEC support for ICCP blocks is indicated below. Additional blocks will be delivered under Oracle Utilities Update Service.

BLOCK	DESCRIPTION	CLIENT	SERVER
Block 1	Basic Services	-	-
Block 2	Extended Dataset Condition Monitoring	-	-
Block 3	Blocked Transfers	-	-
Block 4	Operator Stations	-	-
Block 5	Device Control	-	-
Block 6	Programs		
Block 7	Events	-	-
Block 8	Accounts		
Block 9	Time Series	P	P

Key: - = supported in current release, P = planned

Table A-1. Oracle Utilities ICCP Conformance Block Support

Table A-2. Oracle Utilities ICCP MMS Support

Each ICCP building block requires certain MMS services. The following table indicates the MMS services required by the block and Oracle Utilities LEC support for those services.

MMS SERVER	LEC SUPPORT
Block 1 – Basic Services	
Initiate	-
Conclude	-
Abort	-
Reject	-
Identify	-
GetNameList	-
Read	-

Write	-
InformationReport	-
GetVariableList	-
DefineNamedVariableist	-
GetNamedVariableLIstAttributes	-
Block 2 – Extended Conditions	
No additional MMS services	
Block 3 – Extended Conditions	
No additional MMS services	
Block 4 – Operator Station Message	
Output	
Block 5 – Interlocked Device Control	
No additional MMS services	
Block 6 – Programs	
Start	-
Stop	-
Resume	-

Table A-2. Oracle Utilities ICCP MMS Support

Table A-3. Oracle Utilities ICCP MMS CBB Support

ICCP requires certain MMS Parameter Conformance Building Block (CBB) to be supported and indicates other optional CBBs. The following table indicates Oracle Utilities LEC support for these CBBs.

MMS CBB	LEC SUPPORT
Required CBBs	
STR1	
STR2	
VNAM	
VLIS	
Optional CBBs	
VALT	

Table A-3. Oracle Utilities ICCP MMS CBB Support

Table A-4. Oracle Utilities ICCP PICS

All mandatory features for completed ICCP blocks have been implemented. P, followed by a block number indicates that the option is pending.

ASSOCIATION MANAGEMENT	ORACLE UTILITIES LEC CLIENT	ORACLE UTILITIES LEC SERVER
QOS		
DATA VALUES		
VCC – Specific Scope		
ICC – Specific Scope		
Get Data Value Operation		
Get Data Value Name Operation		
Get Data Value Type Operation		
DATA SETS		
VCC – Specific Scope		
ICC – Specific Scope		
Create Data Set Operation		
Delete Data Set Operation		
Get Data Set Element Values Operation		
Get Data Set Names Operation		
Get Data Set Element Names Operation		
DS TRANSFER SETS		
Interval TimeOut		
Object Change		
Operator Request		
Integrity Timeout		
Other External Event		
EventCode Requested		
TLE		
Buffer Time		
Integrity Check		
DS Conditions Requested		

Block Data		
Critical		
RBE		
TIME SERIES TRANSFER SET OBJECTS		
End Time Arrived	P-Block 9	P-Block 9
ReportIntervalTimeOut	P-Block 9	P-Block 9
OperatorRequest	P-Block 9	P-Block 9
TRANSFER ACOUNT TRANSFER SET OBJECTS		
Before The Hour		
Dispatch Update		
During The Hour		
After The Hour		
Actual Data Update		
Past Hours		
Object Change		
Operator Request		
SPECIAL TRANSFER SET OBJECTS		
Transfer Set Name		
Next DStrasfer Set		
Next TSTransfer Set		
Event Code		
DSCConditionsDetected		
TSConditionsDetected	P-Block 9	P-Block 9
TAConditionsDetected		
Transfer Set Time Stamp		
DEVICES		
Get Tag		
Set Tag		
Timeout Action		
Local Reset Action		
Success Action		

Failure Action		
PROGRAM		
Get Program Attributes Operation		
Event Enrollment		
Delete Event Enrollment Operation		
Get Event Enrollment Attributes Operation		

Table A-4. Oracle Utilities ICCP PICS

Connect with us

Call **+1.800.ORACLE1** or visit **oracle.com/utilities**. Outside North America, find your local office at: **oracle.com/contact**.

blogs.oracle.com/utilities linkedin.com/company/oracle-utilities twitter.com/oracleutilities