



LiveData! Real-time Integration Solutions™

The LiveData ICCP Server

A Configuration-Driven ICCP Solution that Minimizes Code Development

White Paper

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Executive Summary

The LiveData ICCP Server is an ICCP processor which can function as a standalone ICCP node or can enable the easy addition of inter-control center communications protocol (ICCP) capabilities to new and existing SCADA, EMS, and DCS systems. It supports ICCP communications on wide area ICCP links between utility control centers, utilities, power pools, regional control centers, and non-utility generators. In addition, the LiveData ICCP Server provides an ideal way to manage data flows to other utility applications, including outage management systems and substation automation.

The LiveData ICCP Server supports a complete range of ICCP applications, from distribution SCADA to Energy Management System (EMS) to Distributed Control System (DCS) applications, running on a wide range of software/hardware platforms including UNIX, VMS, OS/2, Windows NT, and legacy platforms. It also supports easy integration with new and existing utility applications.

The LiveData ICCP Server is a software solution that runs on the most cost-effective hardware platform to provide an ICCP communications processor for new or existing SCADA/EMS/DCS systems. It supports a range of scalability from low-end PC to high-end multiprocessor RISC hardware under the Microsoft Windows NT operating systems. The LiveData ICCP Server's high level of integration with the Windows user interface results in an ICCP solution that is easy to manage and administer.

The LiveData ICCP Server is designed for easy integration by original equipment manufacturers, value-added resellers, system integrators, and utility engineering staff. The LiveData ICCP Server is based on LiveData's standard off-the-shelf software product, LiveData Server, which features a rich set of integration methods that can be easily applied to new and existing SCADA/EMS/DCS systems. These integration methods include interprocess messaging, SCADA, file sharing, MMS, and database access for popular database products.

The LiveData ICCP Server is the first ICCP solution that uses an object configuration-driven approach to minimize the cost and complexity of developing and maintaining ICCP. As a result, it enables the creation of the most highly maintainable, flexible ICCP system possible.

LiveData believes that ICCP will play a major role in both intra-utility and inter-utility integration strategies across a wide range of utility applications. As utilities become more familiar with ICCP, it will become a strategic tool for achieving integration goals.

LiveData - Your Single Source for ICCP

LiveData is the **only** ICCP vendor that develops, owns, and supports all 7 ICCP layers. Unlike other vendors you might consider, we own and understand every line of code you will be depending on for your ICCP solution. This includes the full 7-layer OSI protocol stack (including MMS, TP4, and RFC 1006) and the ICCP protocol implementation. This means that, as a LiveData 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.

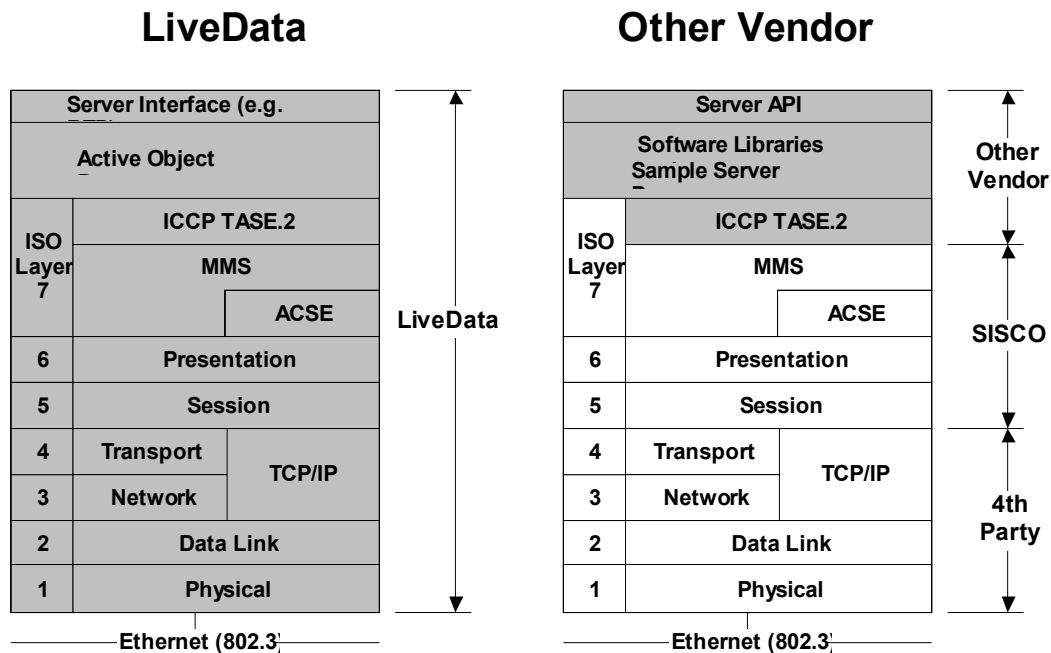


Figure 1. A comparison of LiveData's ICCP implementation with other ICCP implementations.

Proven Server Executable, Not Software Libraries

LiveData Server provides a complete communications data path from the incoming ICCP connection to your system. With LiveData Server you benefit from a proven robust executable rather than having to build a custom 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 LiveData executable and are proven in mission critical applications at customer sites including General Motors, Ford Motor Company, Kansas City Power & Light, and Northern States Power. As a result, your ICCP solution is assured of getting implemented faster and running more reliably.

An Overview of ICCP

The Inter-Control Center Communications Protocol (ICCP) is being specified by utility organizations 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. ICCP is also an international standard: International Electrotechnical Commission (IEC) Telecontrol Application Service Element 2 (TASE.2).

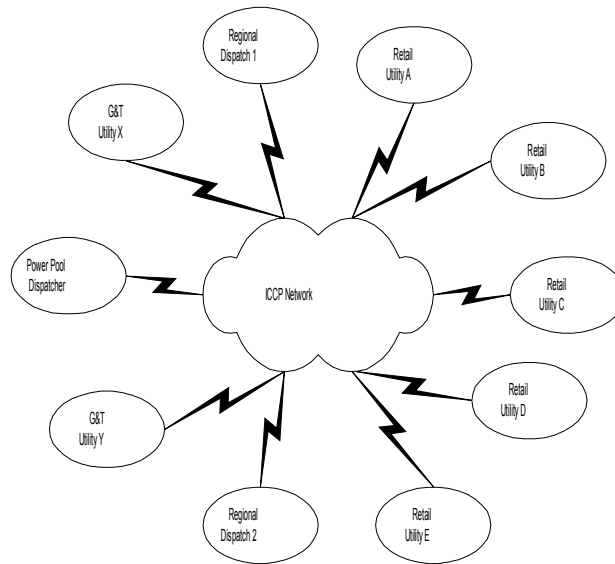


Figure 2. A typical ICCP power pool network.

ICCP allows 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: 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. Figure 3 shows a typical SCADA/EMS/DCS ICCP configuration.

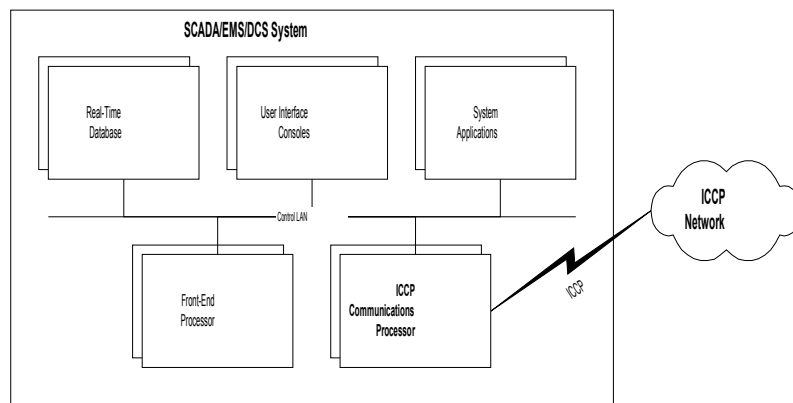


Figure 3. A typical ICCP system configuration.

The LiveData ICCP Server

LiveData's ICCP solution is designed for easy integration with SCADA/EMS/DCS systems by OEMs, system integrators, and end users. Figure 4 shows the LiveData ICCP Server, along with other system components and data flows. The LiveData ICCP Server runs in one or more standalone 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, described on page 5.

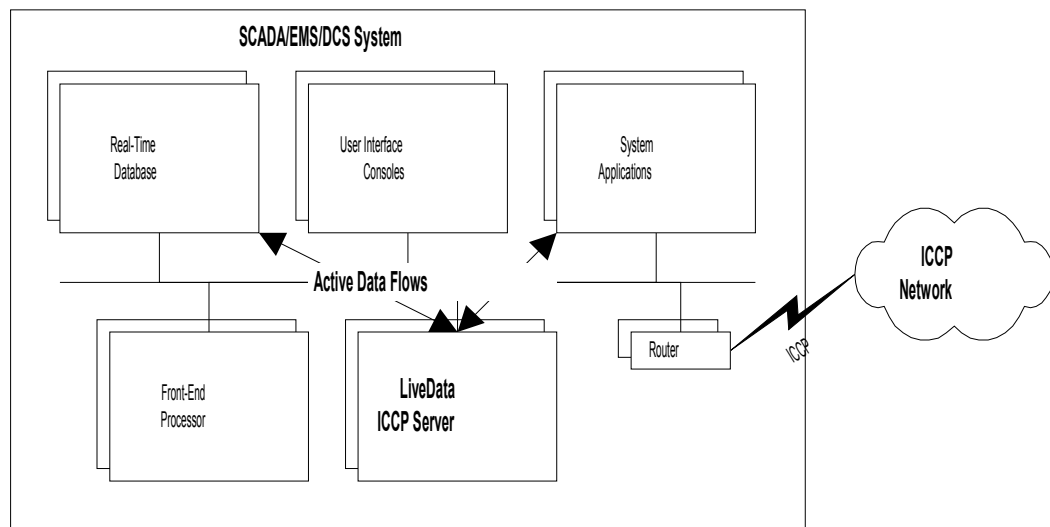


Figure 4. LiveData ICCP Server system components and data flows.

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

The LiveData ICCP Server features built-in support for redundant ICCP communications processors. Data is automatically replicated between redundant servers, and redundant network paths are supported intrinsically by the LiveData ICCP Server's software architecture. Redundant LiveData ICCP 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 specifies the integration of a 7-layer protocol stack with EMS/SCADA system applications. The 7 layers of ICCP, including the ICCP objects and system-specific objects are implemented on the LiveData ICCP Server processor. Figure 5 shows how the LiveData ICCP Server implements the ICCP layers and integrates with SCADA/EMS/DCS systems. The LiveData ICCP Server can communicate with SCADA/EMS/DCS systems using a number of built-in server interfaces.

The LiveData ICCP Server limits the customization and integration required for each SCADA/EMS/DCS system to configured system-specific System Virtual Device and Bilateral Table Objects in the LiveData ICCP Server. These elements are shown shaded in Figure 5.

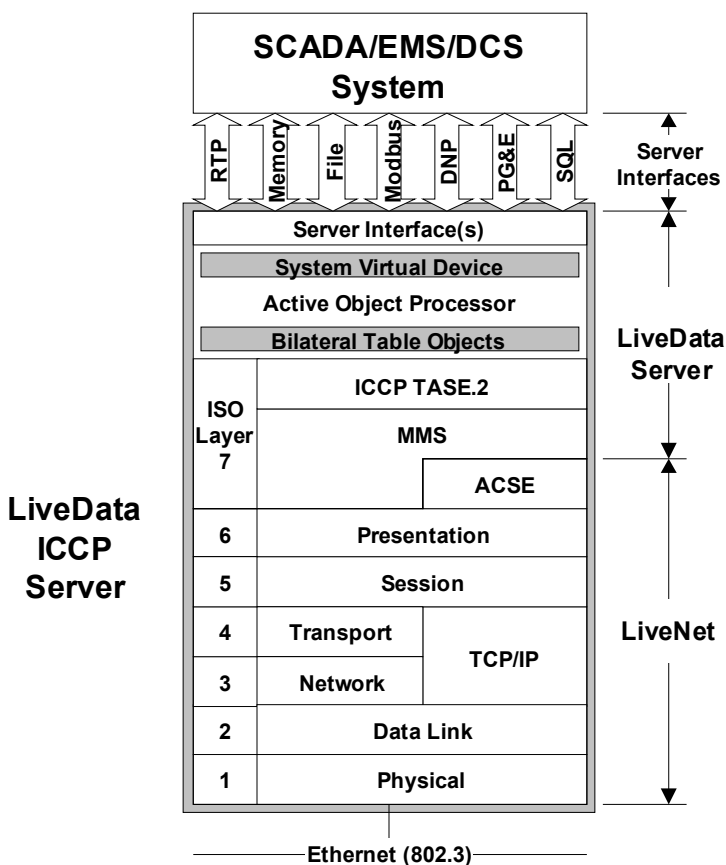


Figure 5. LiveData ICCP Server integration architecture.

The components of the LiveData ICCP Server, starting from Layer 7 and moving down, are described below:

- **LiveData Server** - Layer 7 is LiveData Server, which provides the highest-performance 32-bit MMS client-server available in the world today. It provides MMS client, MMS server, on-line object management, real-time procedures, and interprocess communications capabilities. On Windows NT, LiveData Server can be run either as a server executable or a Windows NT Service. Data flows are controlled by bilateral table objects and the system Virtual Device.

The LiveData ICCP Server features a high performance real-time object engine which creates and maintains ICCP objects, and stores and processes real-time procedures and interactions with the EMS/SCADA/DCS system.

- **Built-In Server Interfaces** - LiveData Server 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 systems by OEMs, system integrators and end users. You can select from: LiveData Real-Time Protocol (RTP) which supports interprocess communications, TCP/IP, and NetBEUI; shared memory (physical or virtual); shared file access; Modbus; DNP 3.0; PG&E Protocol/Cooper 2179; and SQL over serial or LAN physical connections. Once you select a server interface and integrate it with your system, the LiveData Server executable allows configuration of all ICCP-specific operations and functions.
- **LiveNet** - LiveData's OSI protocol stack implements layers 1 through 6, and includes ACSE, Presentation, Session, TP4, CLNP, and ES-IS routing in conformance with the ICCP specification. LiveNet includes a 32-bit Windows NT driver and the capability to do OSI and TCP/IP simultaneously. LiveNet is implemented as 32-bit code and runs in the Windows NT kernel to provide unequalled robustness, performance, and scalability. LiveNet is Windows NT multiprocessor-safe to enable users to take advantage of the multi-processor scalability of Windows NT.
- **Network Interface Card** - LiveData uses standard off-the-shelf network interface cards and drivers from vendors such as 3Com, Intel, and SMC to provide the physical and data link layers. No special "intelligent" network adapters are required.

ICCP Object Configuration and Management

LiveData Server implements ICCP communications by dynamically creating a configuration of memory-resident system Virtual Devices and bilateral table objects that implement the data flows and interaction rules of ICCP.

For each remote ICCP peer, LiveData Server 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.

- **System Virtual Device** - The System Virtual Device provides access to SCADA/EMS 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 LiveData "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.

Figure 6 below shows the software architecture of the LiveData ICCP Server.

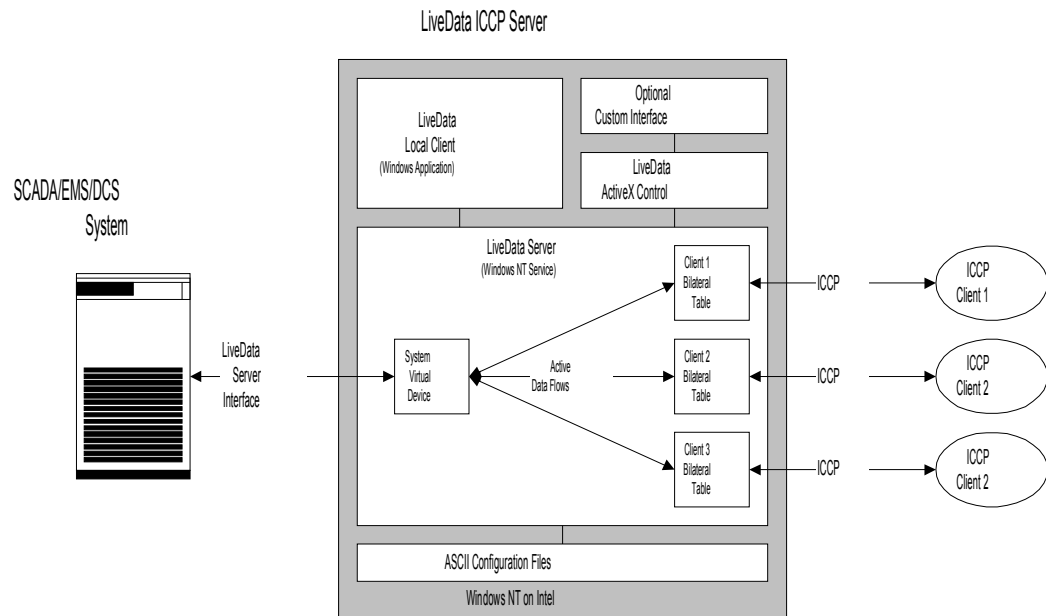


Figure 6. LiveData ICCP Server Software Architecture.

On-Line Configuration and Management

LiveData Server 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.

VCCs and the System Proxy are on-line configurable using the local LiveData Client (which is included in the LiveData ICCP Server software package). New VCCs can be created and populated with objects without shutting the server down. LiveData Server backs this configuration to ASCII files and restores it from these files on startup. An optional add-on component, LiveData Client, allows you to accomplish all this configuration over the network, eliminating the need for someone to be physically at the LiveData ICCP Server to do configuration.

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/EMS/DCS points without shutting the server down. This unique capability allows rapid response to changes in SCADA/EMS/DCS systems or ICCP bilateral agreements.

Off-Line Configuration

Working off-line, or in Batch Mode, you can generate LiveData ASCII configuration (PDI) files. LiveData ICCP Server loads those files on startup. LiveData ICCP Server saves the 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 LiveData Client to develop a Windows interface tailored to your system. LiveData

Client supports your choice of high productivity tools like Microsoft Visual Basic and Visual C++. It also supports your choice of Microsoft's Dynamic Data Exchange, Microsoft's Object Linking and Embedding (OLE) via LiveData's ActiveX Control, and LiveData C API interfaces.

Networks and Platforms

As shown in Figure 7 below, the LiveData ICCP Server typically runs on a separate CPU and acts as a communications processor for your system. The LiveData ICCP Server is purposely designed as a separate communications processor that can be easily integrated with EMS/SCADA systems running on software platforms including UNIX, VMS, and OS/2, as well as legacy platforms. It supports redundant configurations with hot, warm, or cold backup. It communicates with your system using your choice of standard LiveData Server interfaces. It communicates with remote ICCP nodes via Ethernet using standard routers to frame relay, X.25, or other physical WAN environments.

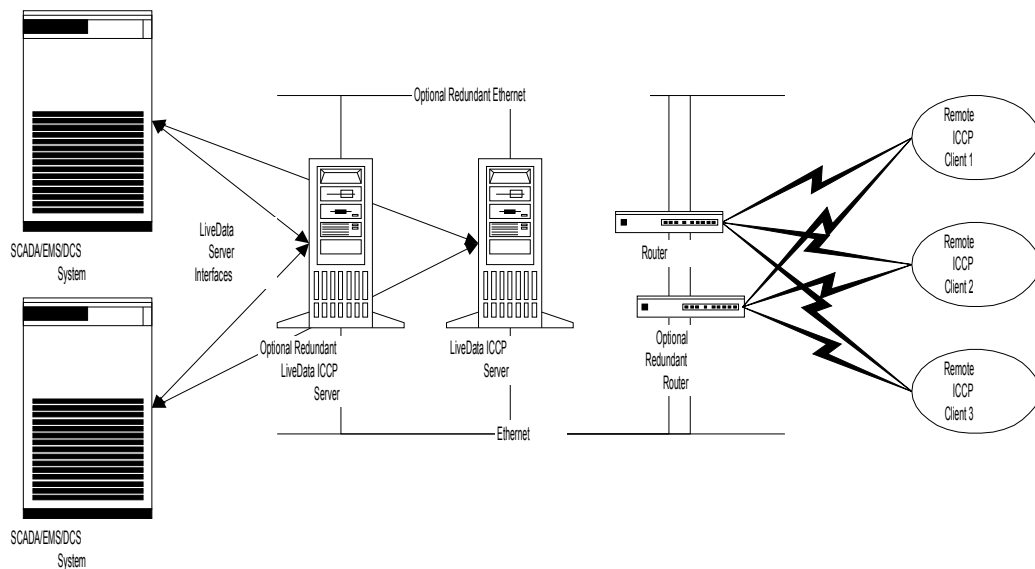


Figure 7. LiveData ICCP Server supports fully redundant system architectures.

Support for OSI, UCA 2.0, TCP/IP, and Other Popular Networks

The LiveData ICCP Server supports the OSI TP4/CLNP network protocols specified by ICCP. It also supports the UCA 2.0 RFC 1006 TCP/IP protocol planned in the next release of the ICCP specification and already in production from all major vendors. The LiveData ICCP Server can run over both OSI and TCP/IP simultaneously. And it supports many popular network infrastructures, such as Novell IPX.

Windows Intel Platform

The LiveData ICCP Server runs under the Windows operating system on Intel platforms. If your system runs on Windows NT or higher, the LiveData ICCP Server can potentially share a CPU with your system components. If not, it can function as a standalone ICCP Server that communicates with your system components, as described above.

Appendix A: ICCP Conformance

Table A-1, LiveData 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. LiveData ICCP Server support for ICCP blocks is indicated below. Additional blocks will be delivered under LiveData Update Service.

| Block | Description | Client | Server |
|---------|---|--------|--------|
| Block 1 | Basic Services | | |
| Block 2 | Extended Data Set 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-2, LiveData ICCP MMS Support

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

| MMS Server | LiveData Support |
|---|------------------|
| Block 1 - Basic Services | |
| Initiate | |
| Conclude | |
| Abort | |
| Reject | |
| Identify | |
| GetNameList | |
| Read | |
| Write | |
| InformationReport | |
| GetVariableAccessAttributes | |
| DefineNamedVariableList | |
| DeleteNamedVariableList | |
| GetNamedVariableListAttributes | |
| Block 2 - Extended Conditions | |
| No additional MMS services | |
| Block 3 - Blocked Transfers | |
| 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 | |
| Reset | |
| Kill | |
| GetProgramInvocationAttributes | |
| Block 7 - Events | |
| EventNotification | |
| DefineEventEnrollment | |
| DeleteEventEnrollment | |
| GetEventEnrollmentAttributes | |
| Block 8 - Accounts | |
| No additional MMS services | |
| Block 9 - Time Series | |
| No additional MMS services | |

Table A-3, LiveData 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 LiveData ICCP Server support for these CBBs.

| MMS CBB | LiveData Support |
|----------------------|------------------|
| Required CBBs | |
| STR1 | |
| STR2 | |
| VNAM | |
| VLIS | |
| Optional CBBs | |
| VALT | |

Table A-4, LiveData 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 | LiveData ICCP Server | |
|--------------------------------|----------------------|--------|
| | Client | Server |
| QOS | | |
| Data Values | | |
| VCC - Specific Scope | | |
| ICC - Specific Scope | | |
| Get Data Value Operation | | |
| Set Data Value Operation | | |
| Get Data Value Names Operation | | |
| Get Data Value Type Operation | | |
| Data Sets | | |
| VCC - Specific Scope | | |
| ICC - Specific Scope | | |

| Data Sets (continued) | Client | Server |
|---------------------------------------|---------------|---------------|
| Create Data Set Operation | | |
| Delete Data Set Operation | | |
| Get Data Set Element Values Operation | | |
| Set Data Set Element Values Operation | | |
| Get Data Set Names Operation | | |
| Get Data Set Element Names Operation | | |
| DS Transfer Sets | Client | Server |
| Interval TimeOut | | |
| Object Change | | |
| Operator Request | | |
| Integrity Timeout | | |
| Other External Event | | |
| EventCode Requested | | |



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| | | |
|---|----------------------|----------------------|
| TLE | | |
| Buffer Time | | |
| Integrity Check | | |
| DS Conditions Requested | | |
| Block Data | | |
| Critical | | |
| RBE | | |
| Time Series Transfer Set Objects | <i>Client</i> | <i>Server</i> |
| End Time Arrived | P-Block 9 | P-Block 9 |
| ReportIntervalTimeOut | P-Block 9 | P-Block 9 |
| Operator Request | P-Block 9 | P-Block 9 |



| Transfer Account Transfer Set Objects | <i>Client</i> | <i>Server</i> |
|--|---------------|---------------|
| Before The Hour | | |
| Dispatch Update | | |
| During The Hour | | |
| After The Hour | | |
| Actual Data Update | | |
| Past Hours | | |
| Object Change | | |
| Operator Request | | |

| Special Transfer Set Objects | <i>Client</i> | <i>Server</i> |
|-------------------------------------|---------------|---------------|
| Transfer Set Name | | |
| Next DSTransfer Set | | |
| Next TSTransfer Set | | |
| Event Code | | |
| DSConditionsDetected | | |
| TSConditionsDetected | P-Block 9 | P-Block 9 |
| TAConditionsDetected | | |
| Transfer Set Time Stamp | | |

| Devices | <i>Client</i> | <i>Server</i> |
|--------------------|---------------|---------------|
| Get Tag | | |
| Set Tag | | |
| Timeout Action | | |
| Local Reset Action | | |
| Success Action | | |
| Failure Action | | |

| Program | <i>Client</i> | <i>Server</i> |
|----------------------------------|---------------|---------------|
| Get Program Attributes Operation | | |

| Event Enrollment | <i>Client</i> | <i>Server</i> |
|---|---------------|---------------|
| Delete Event Enrollment Operation | | |
| Get Event Enrollment Attributes Operation | | |