SCADAMETRICS
WHITE PAPER

Integration Of Custody Transfer Meters Into a Water Utility's Monitoring System Using a Hosted SCADA Solution, the EtherMeter®, and the Iridium Satellite Constellation.

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Background

Within today's modern Water Utility there exists a compelling need to closely monitor flow-rates and totalized consumption of water as it flows through the distribution system's major arteries. And nowhere is the need more important than at the remote custody transfer master meters – the locations where large volumes are sold to connected bulk water utility customers.

And if the goal is to achieve efficient monitoring of the Water Utility's bulk flows, then the purpose of this white paper is to detail the meter data collection system architecture that can be implemented within the framework of a SCADA system.

The methods described herein were developed and implemented by the SCADA engineers at Preferred Controls Inc. (Albany, MN) and the EtherMeter development team at SCADAmetrics (St. Louis, MO.)

The Problem

Within a Water District service area, water is transferred to bulk customers at master meter locations. The water meters may consist of various-sized large flow meters. The regular collection of meter totalizations and flow rates is desired for both billing and operations.

However, reading the meters manually may present a safety problem, as most meters reside in underground vaults, Certain meters may be located in locations with extreme climates, and may be inaccessible during winter months. The labor and vehicle mileage required to read the meters may be costly. The locations may be outside the range of cellular data service. Utility power may also not be available at metering sites, or the cost to install and maintain an electric service may be prohibitive.

Goals

- Achieve Revenue-Grade Accuracy With Encoder-Type Water Meter Registers.
- Post-Process The Raw Data For Process Visualization and Report Generation.
- Provide All Power Using Solar Technology To Eliminate Utility Power Dependence.
- Utilize Extraterrestrial Satellite Network To Eliminate Cellular Infrastructure Dependence.

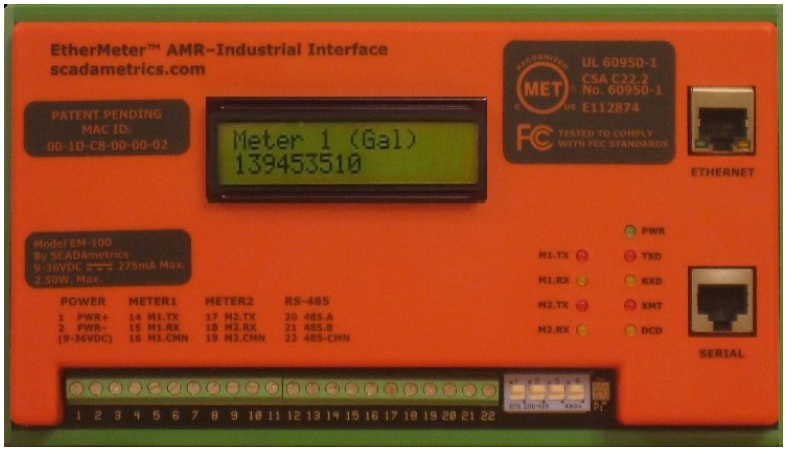
Implementation

1. Enhanced SCADA/Meter Endpoint With Satellite Uplink Capability

Encoder Technology. Within the AMI/AMR arena, encoder-type meter registers have supplanted pulse-based metering due to superior accuracy; and the EtherMeter was designed to fulfill the industry's need for an instrument that converts encoder-type signals to industrial protocols, such as Modbus, DF1, and EtherNet/IP.

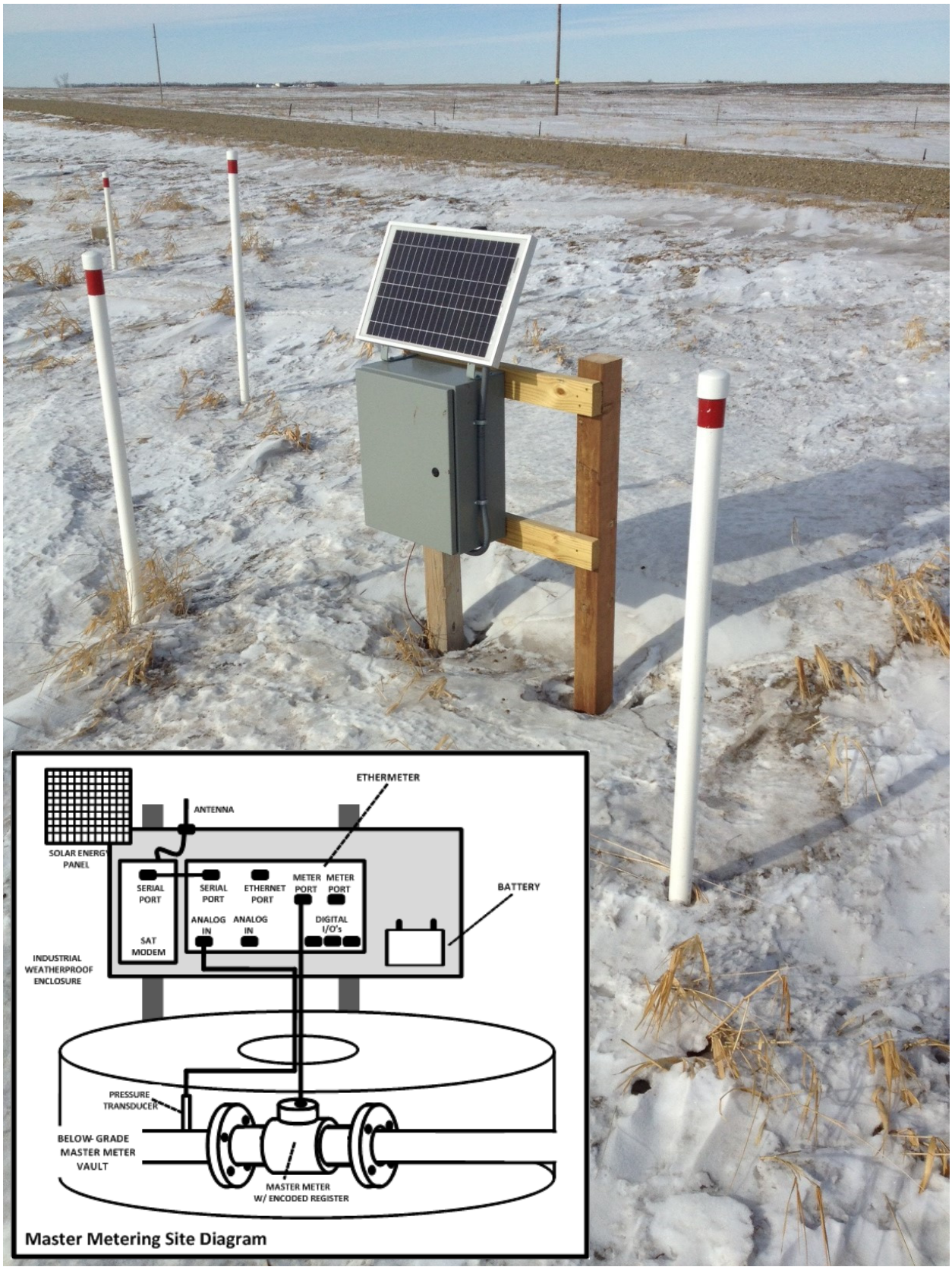
Poll/Response Versus Push. However, in a satellite-based application where bandwidth is at a premium, the network is much more efficiently utilized when data is actively "pushed" up to the satellite network, as opposed to "pulled" via a master/slave industrial protocols. In master/slave protocols, billable bytes are transmitted in both directions; whereas in the proposed satellite push network, billable bytes are transmitted in only one (from the meter to the satellite).

Modem Driver Firmware. Special firmware was written for the EtherMeter that gave it the ability to communicate with an attached Iridium Satellite Modem – specifically the JouBeh 9602W SBD (Short Data Burst) Transceiver. The firmware functionality for transmitting and parsing handshake signals with the Transceiver (an extended AT command set), and functionality that allowed the user to customize the formation of the data to be transmitted. Along with meter totalization and flow rate data, enhanced satellite data fields include Satellite Signal Strength Margin (dB), Battery Voltage, and Meter Tamper Detect. In addition to its 2 meter input channels, the EtherMeter has 3 digital I/O and 2 analog input channels. Possible uses for the analog input channels include pressure and chlorine monitoring. One of the digital I/O channels is dedicated to turning OFF the Satellite Modem between transmissions in order to conserve battery energy.

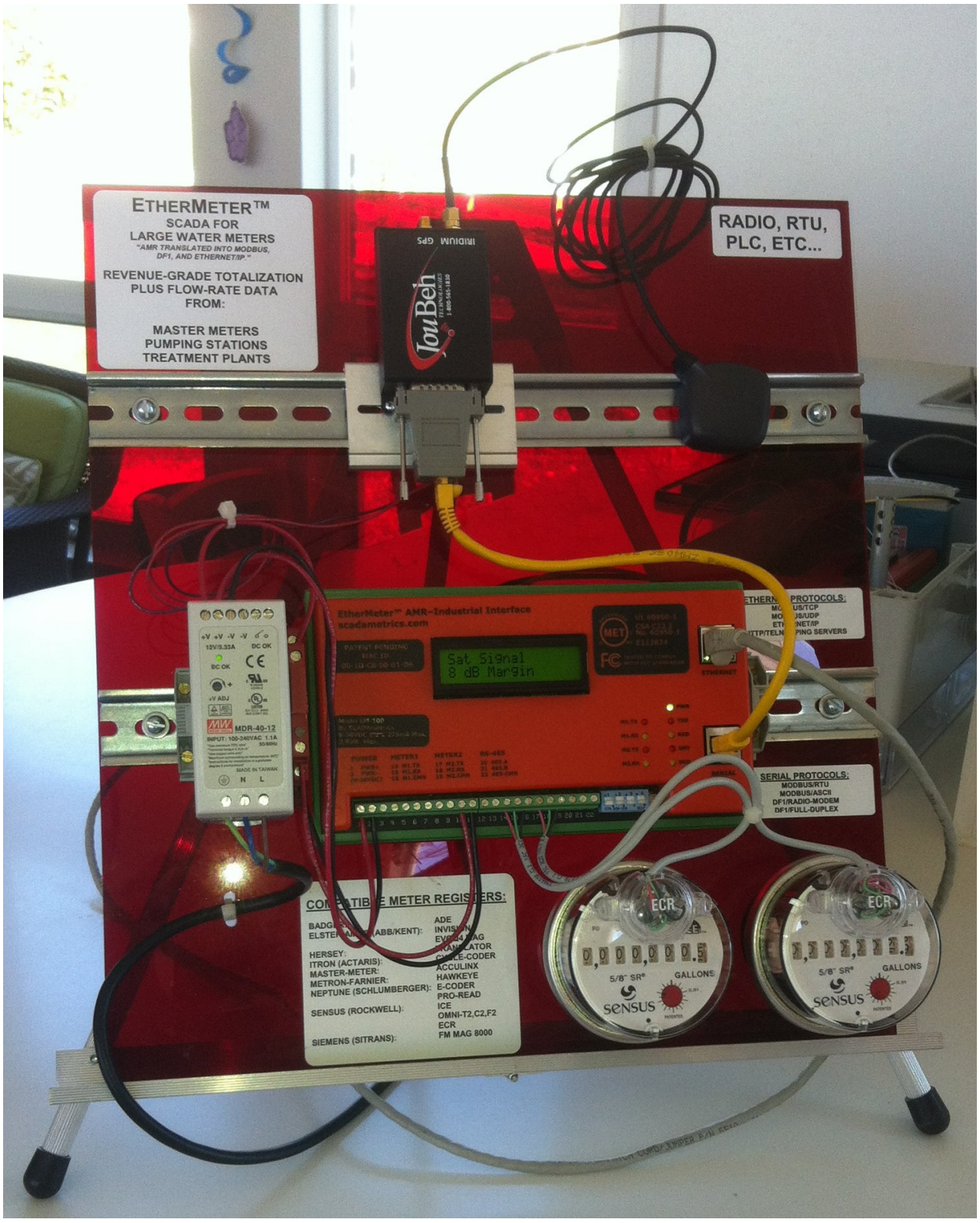


EtherMeter SCADA/Meter Gateway
Equipped With Iridium Satellite Firmware.

JouBeh 9602W SBD Satellite Transceiver
Features RS-232 Serial Interface.



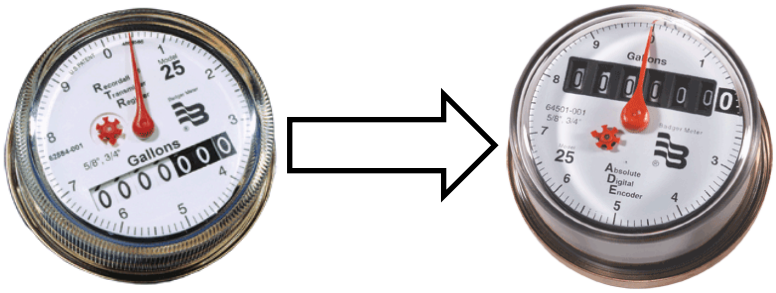
Master Meter RTU Installation (North Dakota).
The Enclosure Contains An EtherMeter, Solar Charge Controller, Battery, and Satellite Modem.
The Meter Is Installed In An Underground Vault.



Development Platform For the EtherMeter / Satellite Firmware.

2. Achieve Revenue-Grade Accuracy With Encoder-Type Water Meter Registers.

In the described project, the water meters were Badger Turbo Meters that were equipped with RTR pulse-type registers. In this case, the registers that sit atop the meters required a simple replacement, as pulse-type registers were replaced with encoder-type (ADE). Fortunately, replacement of the existing Badger meter bodies was not required – a process that would have been costly, labor-intensive, and furthermore would have required taking the pipeline offline during installation.



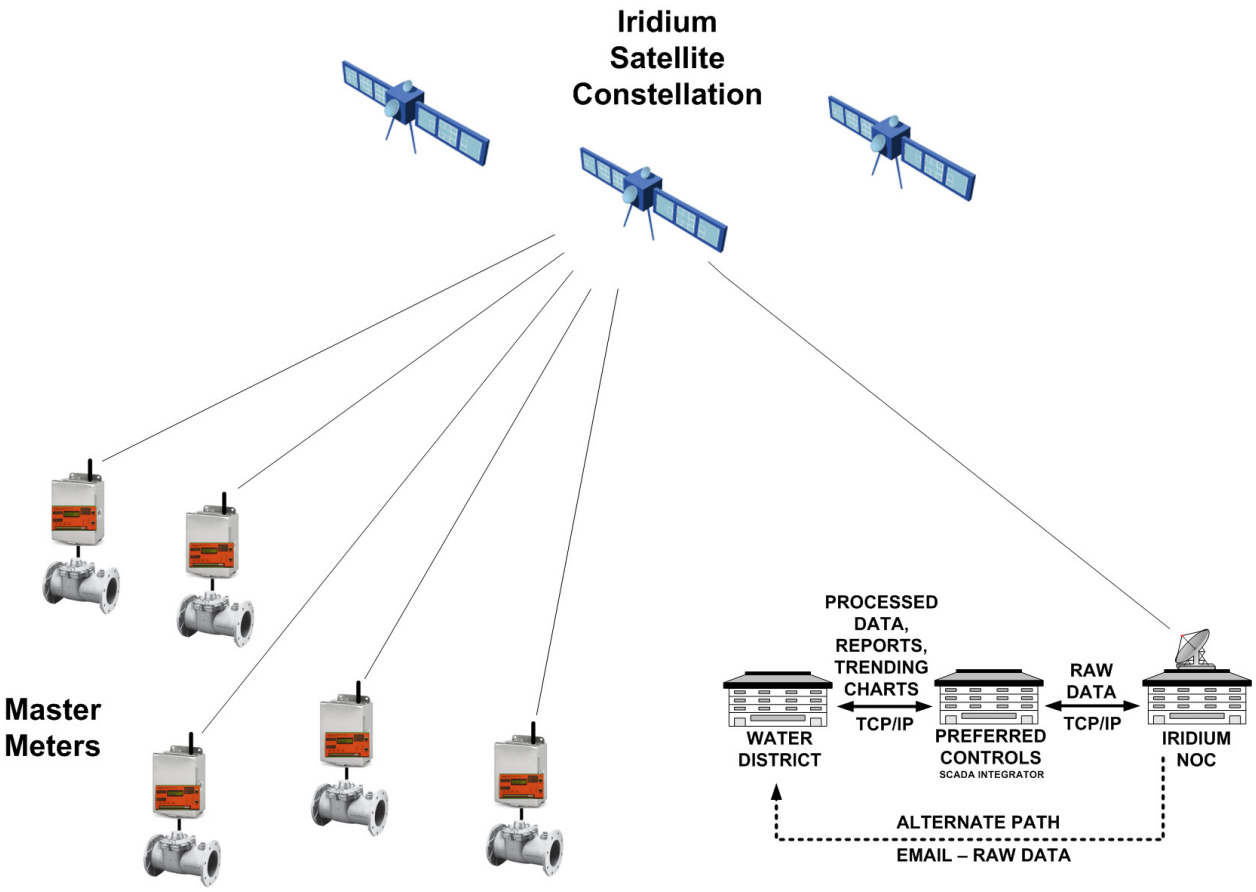
Badger RTR (Pulse) Registers (Left) Were Replaced With Badger ADE (Encoder) Registers (Right).

3. Raw Data Post-Processing

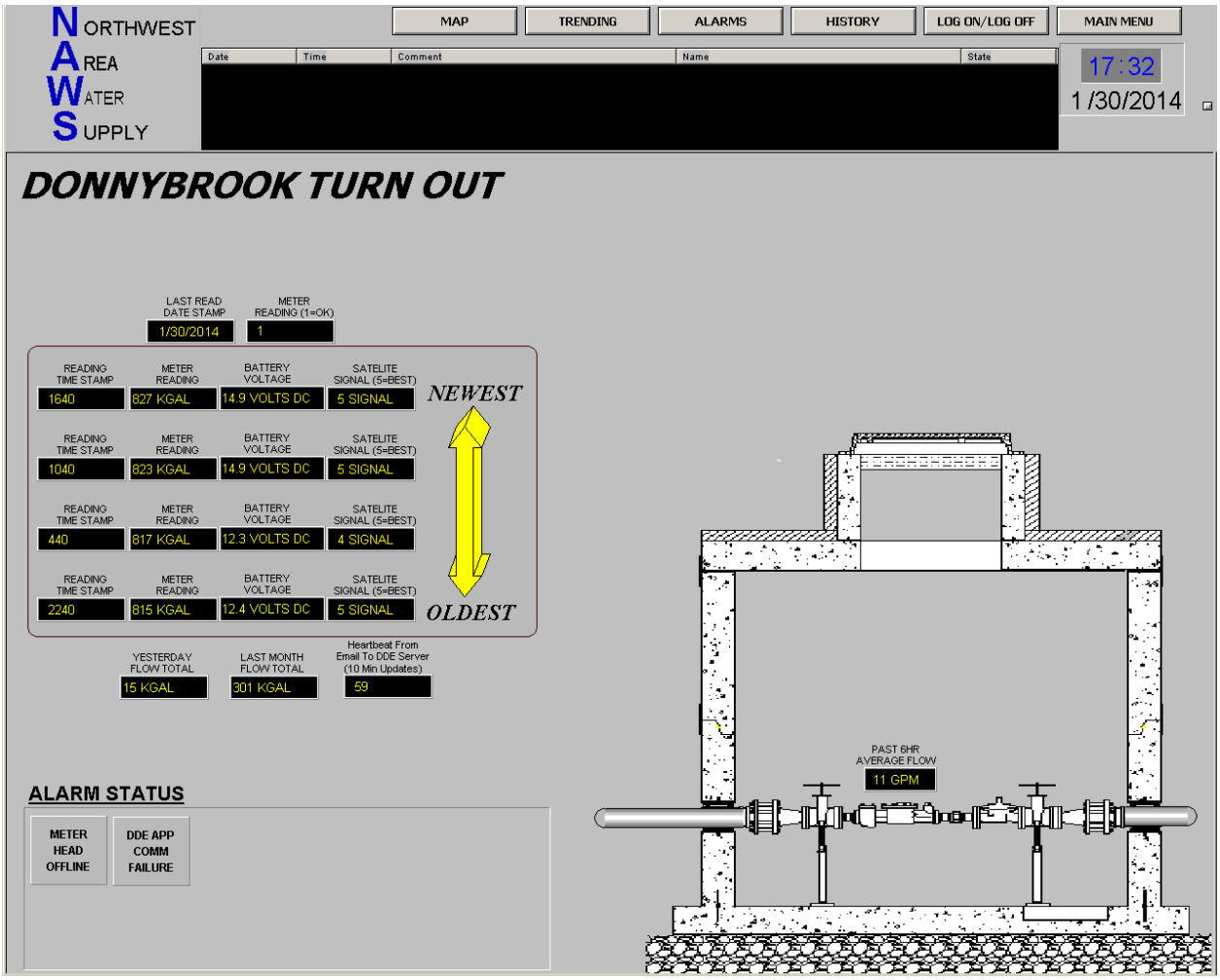
Iridium Short Burst Data (SBD) is a simple and efficient network transport capability for transmitting short data messages between equipment and centralized host computer systems. It is integrated by Iridium's Value Added Resellers into vertical market applications in industries such as Utilities, Oil & Gas, Rail, Maritime, Aeronautical, and Government/Military.

At its most basic implementation, the short data messages are transmitted to the end-user as a text attachment to an email. For certain small applications, such raw email transmittals may comprise an acceptable complete solution.

However, in order to implement graphical process visualization and automatic report generation, the raw data must be retrieved automatically, inserted into a database, and exported into a SCADA visualization and reporting system. The software framework to accomplish these tasks was built by the software development team at Preferred Controls Inc. (Albany, MN). The developed software package completed the project into a turnkey hosted metering solution that can be provided to customers on any continent.



Turnkey Master Metering System Overview



SCADA System – Data Visualization

DonnyBrook Satellite Data Detail Report

DATE	SATELLITE READ DATE	SATELLITE READ TIME (24HR)	METER READING	PANEL BATTERY VDC	SATELLITE SIGNAL STRENGTH
01/01/2014	1/1/2014	1042 H:M	312KGAL	12.5VDC	5 DB
01/01/2014	1/1/2014	442 H:M	308KGAL	12.6VDC	5 DB
01/01/2014	1/1/2014	1642 H:M	320KGAL	12.7VDC	4 DB
01/01/2014	1/1/2014	2242 H:M	325KGAL	12.8VDC	5 DB
01/02/2014	1/2/2014	442 H:M	326KGAL	12.1VDC	5 DB
01/02/2014	1/2/2014	1042 H:M	332KGAL	12.3VDC	5 DB
01/02/2014	1/2/2014	1642 H:M	337KGAL	12.4VDC	5 DB
01/02/2014	1/2/2014	2242 H:M	341KGAL	12.6VDC	5 DB
01/03/2014	1/3/2014	2242 H:M	357KGAL	12.2VDC	5 DB
01/03/2014	1/3/2014	442 H:M	343KGAL	12.4VDC	5 DB
01/03/2014	1/3/2014	1042 H:M	348KGAL	12.4VDC	5 DB
01/03/2014	1/3/2014	1642 H:M	353KGAL	12.3VDC	5 DB
01/04/2014	1/4/2014	2242 H:M	374KGAL	12.4VDC	5 DB
01/04/2014	1/4/2014	1642 H:M	369KGAL	13.2VDC	5 DB
01/04/2014	1/4/2014	442 H:M	359KGAL	12.VDC	5 DB
01/04/2014	1/4/2014	1042 H:M	362KGAL	14.4VDC	5 DB
01/05/2014	1/5/2014	442 H:M	375KGAL	12.2VDC	5 DB
01/05/2014	1/5/2014	1042 H:M	379KGAL	15.VDC	5 DB
01/05/2014	1/5/2014	1642 H:M	385KGAL	12.6VDC	5 DB
01/05/2014	1/5/2014	2242 H:M	389KGAL	12.2VDC	5 DB
01/06/2014	1/6/2014	442 H:M	391KGAL	12.VDC	5 DB
01/06/2014	1/6/2014	1042 H:M	394KGAL	14.9VDC	5 DB
01/06/2014	1/6/2014	1642 H:M	403KGAL	12.7VDC	5 DB
01/06/2014	1/6/2014	2242 H:M	408KGAL	12.4VDC	5 DB
01/07/2014	1/7/2014	2242 H:M	424KGAL	12.4VDC	5 DB
01/07/2014	1/7/2014	1642 H:M	418KGAL	12.8VDC	5 DB
01/07/2014	1/7/2014	1042 H:M	414KGAL	15.VDC	5 DB
01/07/2014	1/7/2014	442 H:M	409KGAL	12.2VDC	5 DB
01/08/2014	1/8/2014	1042 H:M	430KGAL	15.VDC	5 DB
01/08/2014	1/8/2014	1641 H:M	435KGAL	12.8VDC	5 DB
01/08/2014	1/8/2014	2241 H:M	439KGAL	12.5VDC	5 DB
01/08/2014	1/8/2014	441 H:M	425KGAL	12.1VDC	5 DB
01/09/2014	1/9/2014	441 H:M	441KGAL	12.4VDC	5 DB
01/09/2014	1/9/2014	2241 H:M	456KGAL	12.7VDC	5 DB
01/09/2014	1/9/2014	1042 H:M	445KGAL	14.VDC	5 DB
01/09/2014	1/9/2014	1641 H:M	450KGAL	12.9VDC	5 DB

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SCADA System – Automatic Report Generation:
Date, Timestamp, Meter Reading Snapshot, Battery Voltage, Satellite Signal Strength

Donnybrook Daily Detail Report

DATE	DISCHARGE FLOW
01/01/2014	15.0 Kgal
01/02/2014	15.0 Kgal
01/03/2014	15.0 Kgal
01/04/2014	15.0 Kgal
01/05/2014	15.0 Kgal
01/06/2014	15.0 Kgal
01/07/2014	15.0 Kgal
01/08/2014	15.0 Kgal
01/09/2014	15.0 Kgal
01/10/2014	16.0 Kgal
01/11/2014	19.0 Kgal
01/12/2014	21.0 Kgal
01/13/2014	19.0 Kgal
01/14/2014	13.0 Kgal
01/15/2014	14.0 Kgal
01/16/2014	17.0 Kgal
01/17/2014	14.0 Kgal
01/18/2014	15.0 Kgal
01/19/2014	17.0 Kgal
01/20/2014	19.0 Kgal
01/21/2014	14.0 Kgal
01/22/2014	14.0 Kgal
01/23/2014	16.0 Kgal
01/24/2014	14.0 Kgal
01/25/2014	15.0 Kgal
01/26/2014	14.0 Kgal
01/27/2014	15.0 Kgal
01/28/2014	17.0 Kgal
01/29/2014	15.0 Kgal
SUM	453.0 Kgal
AVE	15.6 Kgal
MIN	13.0 Kgal
MAX	21.0 Kgal

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SCADA System – Automatic Report Generation:
Datestamp, Daily Total Usage.

Donnybrook Turn Out Monthly Summary Report

MONTH	METER READING	PANEL BATTERY VDC	SATELLITE SIGNAL
December 2013			
Avg	164 kgal	12.3 VDC	5.0 DB
Min	38 kgal	11.0 VDC	4.0 DB
Max	305 kgal	15.0 VDC	5.0 DB
January 2014			
Avg	558 kgal	12.3 VDC	4.9 DB
Min	308 kgal	11.0 VDC	2.0 DB
Max	815 kgal	15.0 VDC	5.0 DB

SUMMARY FOR ALL MONTHS

AVE	433 kgal	12.8 VDC	4.9 DB
MIN	38 kgal	11.0 VDC	2.0 DB
MAX	815 kgal	15.0 VDC	5.0 DB

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SCADA System – Automatic Report Generation:
Monthly Summary Report

Conclusion

Would the described system solve your master metering needs?

Give us a call. We will be glad to help.

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