Automated Wireless Monitoring of Waste Water Collection Systems

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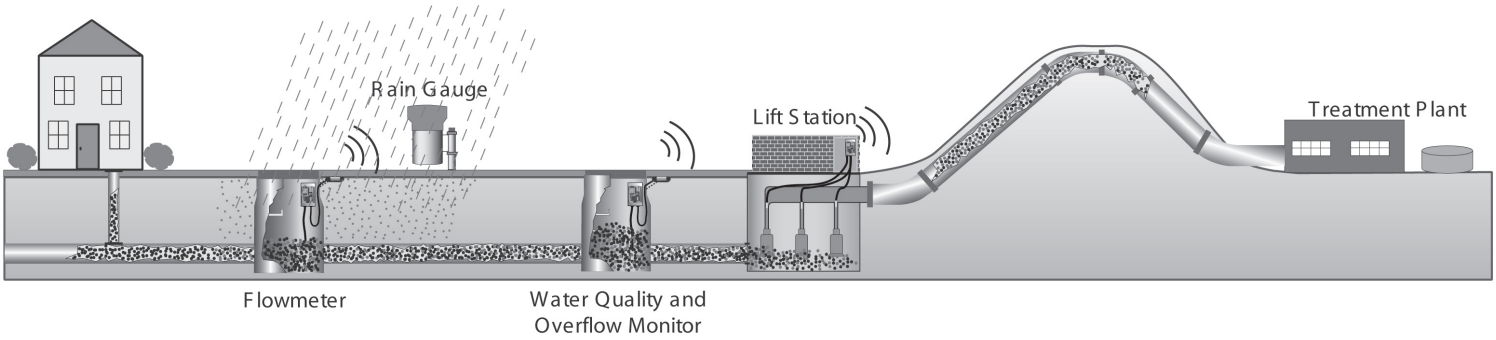
Waster Water Collection System Applications



- Flow meter monitoring
- Rain gauge monitoring
- CSO/SSO surcharge monitoring
- Lift station monitoring
- Water quality monitoring

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What is Telogers?

Telog Instruments, Inc. offers a comprehensive remote monitoring system, *Telogers*, for wastewater collection system operators. ***Telogers*** provides an automated system of collecting, archiving, analyzing, presenting and sharing data from collection system remote assets such as flowmeters, rain gauges, CSO/SSO surcharge sensors, lift stations, pretreatment water quality sensors, and pressure sensors. This document describes the *Telogers* system and addresses specific application solutions for collection system operators. Key benefits of the Telogers system include:

- remote site real-time data
- common data platform for all collection system parameters
- alarm notification and alarm forwarding management
- choice of communication technologies
- compatibility with proprietary flowmeters
- low power remote site operation
- system scalability
- automated operation
- low procurement and lifetime operating cost of ownership

Remote Communication

Telogers remote communication options include:

- telephone
- cellular
- radio
- satellite
- Ethernet

Remote data is automatically transferred to the user's host computer at a schedule defined by the user or in response to alarm conditions. SCADA/HMI polling of remote sites is also supported. Communication options are discussed on page 12.

Collected Data

All collected data is stored in a database included with the *Telogers* host application program. Stored data may be:

1. Displayed or printed in graphical or spreadsheet presentations.
2. Exported in a variety of formats.
3. Shared throughout a network with other workstations operating the *Telogers* software.
4. Transferred to HMI/SCADA systems using industry standard MODBUS or OPC protocol.

Web hosting application software is also available for users who prefer to distribute data in a web page format over a corporate intranet or the Internet. A data hosting service with Internet access is available from Telog. This option is intended to support users who prefer not to manage the Information Technology resources.

Monitoring Applications

Collection system operators use *Telogers* to monitor all remote wastewater system parameters of interest. Using wireless communication, remote site data is forwarded to the operator's host computer network on demand, on schedule (e.g. daily, hourly) or in response to alarm or amplitude exceedance conditions at each site. The following discusses typical applications:

Flow Meters

Telog recorders monitor **flowmeters** using one of the following:

1. Accepting the analog output signals produced by the flowmeter.
2. Interrogating flow parameters via the flowmeter's data communications port.

A battery powered Telog recorder with a wireless modem can be deployed in 1) a manhole or vault with the flowmeter, or 2) installed in an enclosure above ground powered by battery, solar or utility power.

Rain Gauges

Telog recorders can directly interface tipping bucket type **rain gauges**, counting each tip that occurs within user programmed intervals (e.g. 15 minutes). The Telog recorder and communications method consumes very little energy, therefore, a Telog recorder and wireless modem can be deployed with rain gauges operating on battery power for extended time periods without maintenance. Data can be forwarded on a schedule or more frequently during rain events.

CSO/SSO Surcharge Levels

The **Telog *SSO-33*** monitors surcharge levels in sanitary or combined sewers and reports by alarm when levels exceed user defined thresholds. A cellular burial antenna is optionally available with the SSO-33. This antenna can be installed in the road surface next to the manhole.

Lift Stations

Wastewater **lift and pump station** monitoring with the Telogers system provide the operator with information on sump level, pump run-times and flow through the station. Automatic site alarms include sump level overflow, AC power fail, pump temperature and vibration, flow blockage etc.

Water Quality

Telog recorders can be supplied with **water quality** sensors (e.g. pH, ORP, etc.) for waste pretreatment monitoring applications. The recorder, water quality sensors and wireless modem can be deployed entirely underground for permanent applications, or moved from site to site for temporary testing and surveys.

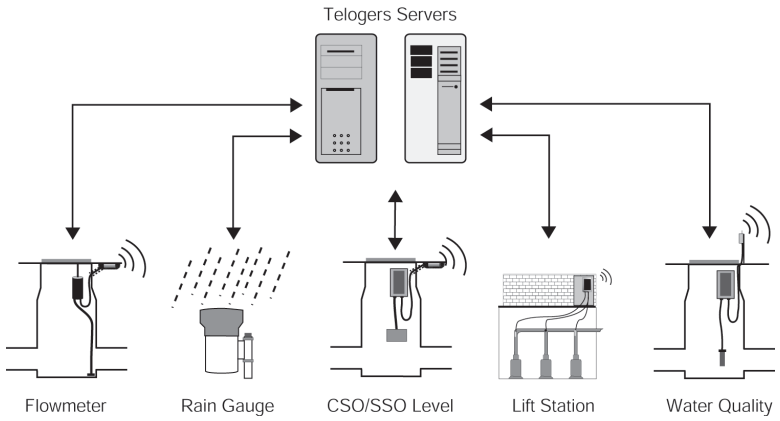


Fig. 1

Common Data Management Platform

Benefits of Common Data Platform

A key benefit of the *Telogers* system is that **data from all collection system monitored sites reside on a common data platform**. This adds efficiency and economy to the tasks of comparing and reporting the relationships of flow, levels, pump activity, water quality and surcharge events in response to normal operation, rainfall events, system blockages, maintenance activities, etc.

Immediate access to historical and real-time data from all key system-monitored parameters during wet-weather events enable operators to make informed decisions when responding to system surcharges and overflows. Time-correlated data showing the consequences of rainfall on system flows, levels, pumps and water quality provide management with quality information tools for emergency preparedness planning and system expansions . Sharing information with associates, consultants, and clients, throughout the utility organization is solid and understandable when all data is presented in a common format correlated will all parameters of interest.

Telogers provides a single supplier solution for the collection and integration of information throughout a wastewater collection system. It eliminates the need and inefficiencies of procuring and maintaining multiple vendor monitoring systems and data management application products.

Wireless Data Technology

Benefits of Wireless Data

Over the past few years, cellular carriers have been actively developing and deploying new wireless data technology. The market opportunity driving this development is to provide mobile cell phone and PDA users the ability to browse the Internet and receive email anywhere.

This new wireless data infrastructure offers features that benefit collection system operators interested in monitoring remote assets. These include:

- the wireless infrastructure is in place; no investment is necessary
- low data rate tariffs (e.g. $10/month per megabyte)
- broad coverage
- low power cellular modems (radios)
- packet switched Internet compatible protocol
- high network reliability

For example, a battery powered Telog recorder monitoring a wastewater flow meter can transfer data following each flow measurement (e.g. every 15 minutes) to the desired application server for $12/month. This is effectively 24/7 real-time flow data, accessible on the operator's office computer network or their handheld PDA when in the field.

Automatic, Economic, Reliable Data Transfer

Furthermore, the communication speed and low transmit power levels (< 200 mWatt) of the Telog embedded wireless modem permits long-term operation on battery or solar power. For example, communication energy cost for hourly data transfers is approximately 10 amp-hours per year.

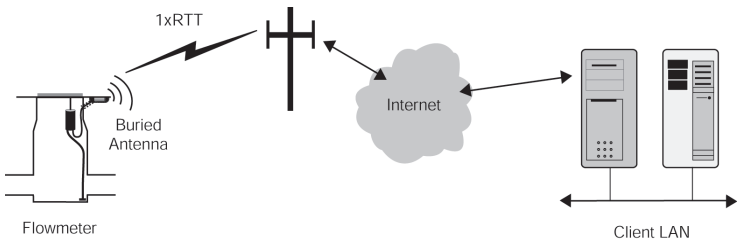


Fig. 2

Using packet switched wireless cellular communication technology (e.g. 1xRTT) data arrives at the host application server via the Internet at Ethernet data rates. Using this communication approach, Telog's application software, *Telogers for Windows* can service hundreds of remote recorders transferring data every 15 minutes. This is real time data from remote, battery powered sites transferring on a schedule or in response to site alarm conditions.

Circuit vs. Packet Switched Data

Circuit Switched

Telogers supports both *circuit switched* and *packet switched* data routing architectures. ***Circuit switched*** refers to an uninterrupted connection through a network in which a bidirectional communication channel is established for the entire communication session. For example, a voice call over a telephone and/or cellular network establishes a continuous circuit between the two parties and would be considered a *circuit switched* call.

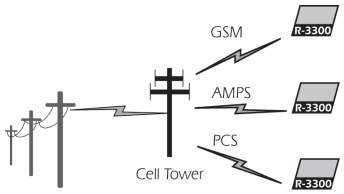


Fig.3

When *Telogers* employs *circuit switched* communication, data arrives at the host computer via a telephone landline connected to the computer's phone modem. Billing is typically based on the duration of time that the circuit is established (call duration), and addressing is performed by phone number dialing.

Typical circuit switched communication technologies include landline telephone (PSTN), analog cellular (AMPS) and digital cellular or (CDMA, GSM and PCS).

Telog supports GSM digital cellular technology (e.g., T-Mobile and Cingular) and CDMA digital cellular (e.g., Verizon). Digital cellular coverage is approaching that of analog cellular. Monthly service fees for a typical Telog remote monitoring site employing *circuit switched cellular* will range from $25 to $35 depending on location, carrier and call schedule utilized.

Because the *circuit switched* connection at the computer is dedicated to a single remote RTU at relatively low bandwidth, the computer can only deal with a few *circuit switched* calls per minute. This creates a bottleneck and dramatically limits real time data applications in large systems. Therefore, *circuit switched* is typically recommended for applications with 20 or fewer RTUs.

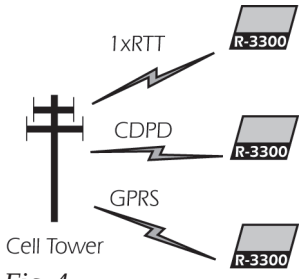


Fig. 4

Although still in use, analog cellular (AMPS) and CDPD (cellular digital packet data), which operate on AMPS, is in the process of phase-out by Verizon and AT&T. CDPD is planned for phase-out in 2005 and AMPS by 2008. Although Telog continues to support AMPS and CDPD today, new service is not available for CDPD and new AMPS service is only available where digital cellular has not been installed.

Packet Switched

Packet switched communication technology refers to data that is transmitted in short bursts (typically 250 byte packets or less) from one address to another over a network. Packets from different sources may arrive at a common destination interleaved.

Telogers supports *packet switched* data over Ethernet and the Internet using TCP/IP or UDP protocol when supporting CDPD, GPRS, 1xRTT or Ethernet communication options. Data from remote recorder sites typically arrive at the operator's host computer via an Ethernet connection over a LAN (Local Area Network). *Packet switched* billing by cellular carriers is based on the volume of data communicated from each remote site, and addressing is via IP (Internet Protocol) addresses.

Packet Switched in Large Systems

Packet switched data offers many advantages in large system applications. The major advantage is that data arrives at the host computer via a LAN (local area network) at high speed permitting the host application to deal with multiple remote RTUs simultaneously. *Telogers* can easily handle an application supporting a few hundred recorders all transferring interval data every 15 minutes. This is possible because the data arrives at the computer in small packets at Ethernet speed (10 MBaud or greater) and the communication session between each RTU and the host involves only a few short packets. Packet collision is automatically managed by network buffering.

Another key advantage of *packet switched* technology is that the data can be routed over the Internet to any computer connected to the Internet. This minimizes communication cost and better supports large geographical networked systems.

Packet switched data service is lower in cost than *circuit switched*. For example, Verizon offers a $12/month rate for 2 Mbytes of data using 1xRTT. A typical flowmeter site might transfer less than 300 Kbytes of data per month making this a very cost effective rate compared to *circuit switched*, which might range from $25 to $35 depending on the carrier.

Remote site power consumption is also lower when using *packet switched* cellular. This is an important consideration in battery or solar powered applications. Call sessions are shorter so the embedded modem is powered-on for less time.

Packet switched applications however do introduce issues, often requiring the client's IT (Information Technology) department become involved. *Packet switched* data over cellular networks arrive at the host computer site generally via an Internet connection, therefore, client firewall security concerns must be addressed. Telog understands network security issues and is prepared to configure the ***Telogers*** installation to ensure the client's security concerns are satisfied.

Telog typically recommends *packet switched* technology in applications where the user plans to deploy 20 or more remote RTUs.

Network Security Concerns

Dealing with Security Concerns

Client computer network security is generally configured to prevent unsolicited Internet transmissions from reaching the client's computer network. Typically, the client's Internet server *firewall* blocks unsolicited data traffic.

Telog understands and agrees with the user's concern for data security. There are multiple methods to ensure that the client's computer network security is observed while permitting remote site data to be collected and routed onto the client's computer network. A few approaches are summarized below. We are available to discuss these and other approaches with the client's IT personnel.

Site ID filtering - Each cellular modem contains a unique S/N and with some cellular data technologies a unique IP address. These electronic numbers are requested and validated by the cellular carrier before the cell modem is permitted to log onto the carrier's network. These identifiers are also transmitted along with each IP data packet. The client's firewall can be configured to accept data transmissions from a specific list of remote monitoring sites to pass through the firewall.

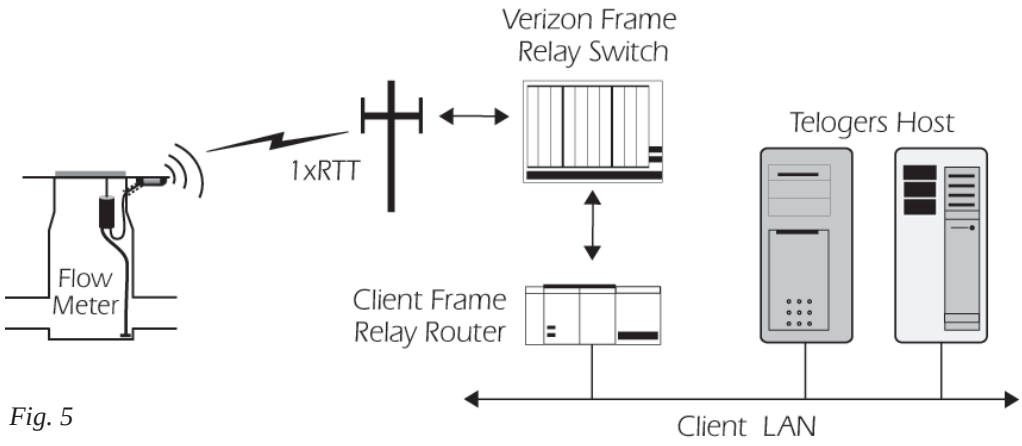


Fig. 5

Bypass the Internet - One sure method of eliminating concerns about routing data onto the client's network via the Internet is to bypass the Internet. Arrangements can often be made with the client's local cellular carrier to route data from cellular modem sites through their network to the client's network without routing via the Internet. The cellular carrier may recommend a Frame Relay switch connection and a DSL line to the client's host computer network. The carrier would only permit traffic from specific cellular units on their network to be routed over the client's DSL line (see *Fig. 5*).

Isolated Telogers Server - The client may choose to establish an isolated *Telogers* server connected to the Internet that would collect and manage data from the remote wireless monitoring sites. This server could be located virtually anywhere although it would typically be installed within the client's data management facility. The isolated server would not be connected to the client's computer Local Area Network (see *Fig. 6*).

The client may then access the Telogers server data from any computer with Internet access. Simply use a common Internet browser and log onto a web page utility running on the *Telogers* server. This is no different than accessing information from any other Internet website (e.g. Yahoo, MSN, etc).

Telog provides this functionality with a software application titled ***Telogers Enterprise*** (discussed later in this paper). *Enterprise* provides administrative access controls (user name and passwords) to permit only authorized personnel access to information. Different levels of access permissions may be provided to the client's employees, consultant engineers and customers.

For clients who prefer to outsource remote data collection and data management tasks, a ***Data Management Service*** (DMS) is offered by Telog. With the Telog DMS, all remote site data is routed to the Telogers server at the Telog Data Center (see *Fig. 6*). The client obtains data by logging onto a website hosted by the Telogers Server. More information on Telog's DMS is included later in this paper.

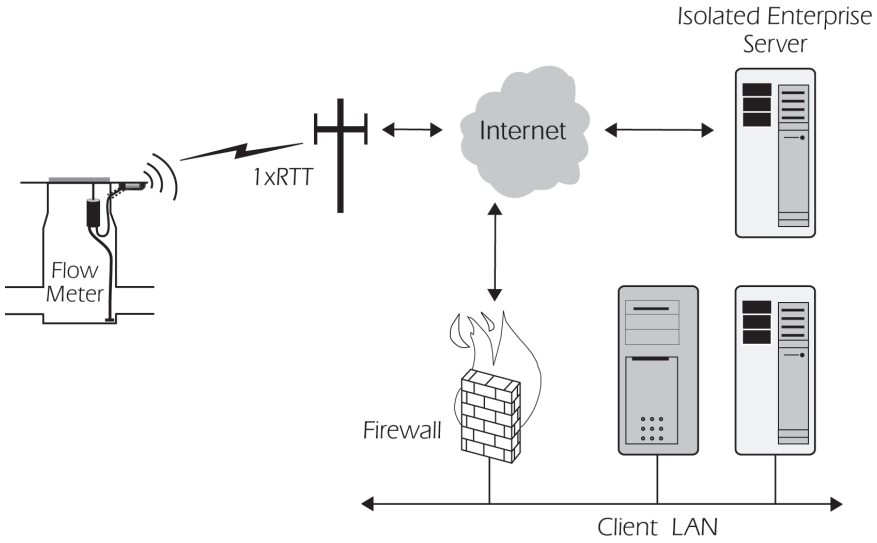


Fig. 6

A Telogers System

The *Telogers* system product model consists of three elements:

1. Remote data recorder
2. Communication
3. Information management

The following discussion elaborates on the operation, features and benefits of each element.

Data Recorder

Telog's R-3300 series data recorder or remote RTU (*Recording Telemetry Unit*) manages the tasks of collecting, storing and communicating data from remote monitoring sites to the host computer application server.

Functions of a Telog data recorder

The data recorder provides the following functions:

- Accepts a variety of analog or discrete signals from sensors and instruments.
- Directly interrogates digital meters via RS-232/485.
- Provides configurable signal conditioning of inputs, (filtering, linearizing, scaling etc.).
- Samples and stores each input at selectable rates in non-volatile memory.
- Computes selectable statistics (i.e. min, max, averages, totals) at synchronized intervals.
- Provides error free communication with the host computer.
- Supports plug-in communication options including:
  - Local RS-232 for portable PC and/or PDA data transfer unit
  - Dial-up telephone
  - Switched circuit cellular (AMPS, GSM & CDMA)
  - Switched packet cellular (CDPD, GPRS & 1xRTT)
  - Ethernet
  - Spread Spectrum unlicensed radio with an embedded 200 mW radio
  - Spread Spectrum and licensed radio networks with external radio modules
- Initiates scheduled data calls and alarm exceedance calls to the host computer.
- Responds to SCADA/HMI polling.
- Provides password protection for data access and/or configuration changes.
- Maintains a recorder log of all significant events, e.g. computer communications, reprogramming events, alarm calls, fault conditions, time-clock adjustments etc.

The Telog remote RTU may be supplied in: 1. NEMA 4x rated enclosures for above ground applications, 2. NEMA 6 rated immersible enclosures for underground applications, or 3. As a loose piece instrument to be mounted in existing enclosures on site. The recorder consumes very little energy, and may be powered with battery, solar or utility power options.

Telogers Communication

The remote Telog recorder communicates with the host computer to:

- transfer data and alarm conditions
- reconfigure computations, schedules and site parameters
- perform clock maintenance
- reconfigure or collect meter (e.g. flowmeter) diagnostics via pass-through access

Typically, all communication between recorder and the host computer are automatic and transparent to the operator with the exception of the last item above, which is an on-demand operation. The computer, the recorder or both may initiate scheduled data calls at any interval rate (e.g. following every flow measurement, hourly etc.). A call scheduling plan needs to take into account the desired timeliness of information, remote site energy consumption and communication cost.

Communication Options

Superior Communication

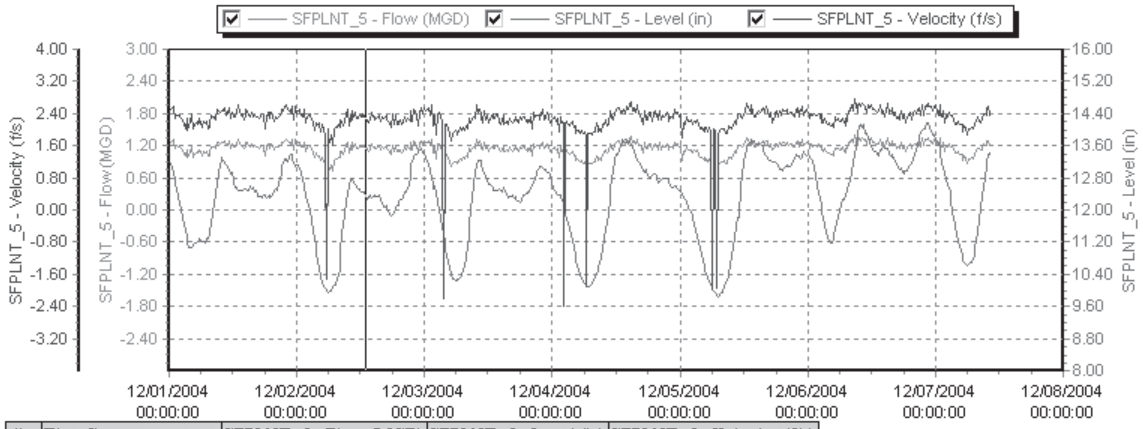
The Telog R-3300 recorder family supports many choices of communication technologies. This variety of choices enables the user to optimize their data acquisition performance, efficiency and economy.

- **Local RS-232 Communication** - An environmental circular connector is installed on each recorder and RS-33 Series enclosure. Use this connector for on-site recorder programming or data collection via portable PC or PDA data transfer unit.
- **Dial-up telephone** - Data communication over voice grade phone line via an FCC approved, 2400 baud auto-answer/auto-dial embedded telephone modem.
- **GSM** - Circuit switched digital cellular is supported over GSM cellular carrier networks (e.g. T-Mobile, ATT and Cingular) supported with an embedded cellular data modem.
- **1xRTT or CDPD** - Packet switched IP protocol data over the Verizon 800 MHz Cellular Network is supported with an embedded cellular data modem.
- **GPRS** - Packet switched IP protocol data over GSM digital networks (e.g. T-Mobile) is supported with an embedded cellular data modem.
- **Ethernet** - Telog's eNET option permits direct connection of Telog recorders to an Ethernet network.
- **SS Radio** - Unlicensed Spread Spectrum Radio can be supported with an embedded 200 mWatt, 2.4 GHz frequency hopping, license free embedded radio. This is recom mended at sites within a two mile line-of-site to the base station antenna.
- **Licensed Radio** - Narrow band licensed radio networks are supported with external digital data radios, e.g. Motorola, MDS, DataRadio, etc.
- **Satellite** – In remote locations where no other communication options are viable, satellite has been effectively used, e.g., in the middle of the Brazilian jungle.

Information Management

Telogers for Windows, is a high performance software support application that operates on 32-bit Microsoft Windows Operating Systems (e.g. Windows 95, 98, NT, 2000 & XP). *Telogers for Windows* includes a royalty free run-time version of the Microsoft *Access* database engine. *Telogers* performs automatic communication with up to hundreds of remote Telog data recorders including call scheduling and information management. The user need only provide time-of-day and/or frequency of calls preferences. *Telogers* manages call activity with the remote recorders.

Telogers also receives and processes alarm calls. This could be the simple logging of an alarm call to a message log or the forwarding of an alarm to field personnel. Alarms can be an alphanumeric message to a paging service provider, cell phone text message or email message to a networked computer. The user selects alarm conditions from a menu of choices including external power failure, input signal hi and low level excedance, battery low, AC power fail, external event triggers, memory nearly full, tamper switch detection, recorder fault conditions, etc.



#	Time Stamp	SFPLNT_5 - Flow (MGD)	SFPLNT_5 - Level (in)	SFPLNT_5 - Velocity (f/s)
145	12/02/2004 12:00:00	1.173	12.459	2.311
146	12/02/2004 12:15:00	1.216	12.43	2.396
147	12/02/2004 12:30:00	1.179	12.461	2.322
148	**12/02/2004 12:45:00**	**1.197**	**12.467**	**2.358**
149	12/02/2004 13:00:00	1.163	12.378	2.292
150	12/02/2004 13:15:00	1.141	12.274	2.248
151	12/02/2004 13:30:00	1.097	12.295	2.161
	Minimum	**-1.22**	**9.85**	**-2.40**
	Average	**1.13**	**12.33**	**2.24**
	Maximum	**1.40**	**14.18**	**2.75**
	Total			

Graph 1

The major functions provided by *Telogers for Windows host application* include:

- Communication with all remote recorders using various protocol and communication technologies.
- Handling real-time alarms and alarm forwarding functions.
- Managing recorder call schedules, clock synchronization, etc.
- Storing and updating all recorder user parameters.
- Downloading new recorder firmware.
- Managing historical data and database management functions.
- Managing computer/recorder passwords.
- Producing a graphical user interface for configuring recorders, viewing historical data and producing reports.

Graphical and spreadsheet format data presentations are selectable; including the ability to view multiple channels or data from multiple remote sites on the same presentation. A variety of report formats may be selected and Telogers provides utilities to export data in a choice of user formats.

Telogers & SCADA/HMI

How Telogers Enhances SCADA

Telogers and *SCADA/HMI* are architecturally different types of systems, but are highly compatible and complementary. *SCADA/HMI* systems employ a real time polling schema which requires a continuous channel of communication between the host server and each remote RTU (*Remote Terminal Unit*). All data measurements are forwarded directly to a host computer in response to polling.

SCADA systems need to operate in this fashion because their primary function is control. Decisions are made at the host CPU following a snapshot of all remote inputs. When a SCADA system is used for data acquisition, this approach is inefficient because of system complexity, data traffic, communication infrastructure cost and data reliability exposure.

Telogers More Effective for Non-mission Critical Points

Telogers is dedicated and optimized for remote data acquisition. A Telog recorder is independently configured to sample each sensor or instrument at the optimum rate for that parameter. For a pressure sensor this might be once every second; for SSO level maybe once per minute; for rain gauges, this might be when it is raining. The recorder performs data reduction on these data samples to produce information with optimum value to the user. This might be the total flow at 15-minute intervals, the amplitude, time stamp or severity of water hammer events, or the time stamp and duration of an SSO event.

The Telog recorder performs data reduction at the point of measurement then uploads to the host computer on a programmable schedule (or on exception) as specified by the user. The total amount of data transferred by Telogers compared to SCADA is typically smaller by an order of magnitude or more. Unlike SCADA the communication link is active only occasionally, and for short periods for example once per hour for 10 seconds. This significantly reduces communication cost and demand on host computer resources.

High Data Reliabiltiy

Furthermore, *Telogers* provides higher data reliability because the information is redundantly stored in the data recorder before, during and after the communication session. In the event a communication channel is lost or the host computer stops operating, data is stored and continues to accumulate in the recorder. When the communication link or computer system is back on-line, all uncollected data is automatically transferred to the computer. Similar failures in a SCADA/HMI system result in lost data.

Telog provides numerous methods for transferring data from the Telogers (or Telogers Enterprise) database to an HMI/SCADA application or historian. The combination of Telogers and SCADA/HMI creates an overall system that efficiently controls mission critical operations while economically gathering vital remote data using the best technical approach for each situation.

Telogers Enterprise

Telogers Enterprise adds three high-performance data management elements to *Telogers for Windows*:

1. Data analysis module
2. Fully relational database
3. Web server application for accessing data over an intranet or the Internet.

Enterprise stores all data from remote sites into a relational database on the server, including all recorder configurations, event logs, site parameters, etc. Any networked computer running the *Enterprise Client* software (with appropriate permissions) may access data stored in the database. Additionally, *Enterprise* serves data to networked users operating common web browsers, (e.g. *Microsoft Internet Explorer*), as web pages. This may include any computers connected to the user's intranet or the Internet.

SQL Database

Telogers Offers Access or SQL Database

Enterprise currently provides support for Microsoft's **SQL Server** and **MSDE** (*Microsoft DataBase Engine*) as the relational database. The MSDE is functionally a small version of Microsoft SQL limited to 2 Gbytes of data and is available from Microsoft license free.

For applications requiring larger databases, (e.g., collecting data from more than 25 remote recorders over many years), we recommend Microsoft SQL Server. The maximum database size for SQL is 1,048,516 Tbytes, effectively limiting the size of one's database to the amount of disk drive space available on the server.

A SQL relational database provides a number of advantages to *Enterprise* users including unlimited database size, increased operational speed producing graphical and numeric reports, and interoperability with third party applications such as HMI, GIS, billing, modeling and corporate ERP systems.

Data Analysis Module

Using Data Analysis

Enterprise includes a Data Analysis application to assist the operator in managing and analyzing data from remote sites. This application includes tools to permit the user to:

- create physical sites and measurements
- create statistical and/or pseudo (virtual) sites and measurements
- create custom reports and report templates
- edit data using manual or automated methods
- produce *NetFlow,* (aggregate), functions and reports
- link pipe tables, silt levels and unique parameters to flow computations
- automatically produce scheduled reports
- rapidly review site measurements
- alarm on measurement anomalies or excedance conditions

Create as Many Measurement Parameters as You Need

The *Enterprise* Data Analysis Module enables the user to create as many measurement parameters as desired for any site. A site is a geographical location, for example a manhole or pipe. For each site, the user may create a few or dozens of measurements; some may be physical measurements obtained from remote RTU channel inputs, such as level, velocity, flow, temperature, pH, etc. Others may be computed measurements such as Manning flow, combined surcharge flow, aggregate flow, etc.

Virtual Sites

Enterprise permits measurements to be assigned to multiple sites and pseudo (virtual) sites. For example, a rain gauge measurement may be associated with multiple flow meter sites for the purpose of producing hydrographs. A virtual site may be created for a site where a flowmeter does not actually exist, but the flow at that site can be determined from a mathematical relationship of measurements produced by other flowmeters or conditions within the collection network.

To illustrate the usefulness of this feature, consider the following example. A remote RTU provides level, velocity and flow measurements from a remote site flowmeter to the *Enterprise* database every 15 minutes. The user has configured *Enterprise* to automatically produce four different flow measurements defined as follows:

1. Metered Flow—as produced by the meter.
2. Continuity Flow—computed using velocity, level, the pipe table, and silt level.
3. Manning Flow—computed using level, pipe table and computed Manning Coefficient.
4. Final Flow—selected from any of the above as a function of site conditions.

It is expected that metered, continuity and Manning flow would generally agree. However site conditions change; silt levels increase, the velocity sensor can become fouled, sites surcharge, etc. By maintaining multiple flow measurements and monitoring the relationship of these measurements relative to one another, the user can be alerted to site problems and maintain data continuity for the site.

Virtual Sites

The user may also edit any of the above flow measurements with the exception of the metered Flow values. *Enterprise* does not permit the user to edit any original data measurements provided from remote RTUs. All edited values are produced by direct user entries or automatically produced by defined calculations and therefore may be removed or changed by the user at a future date. Maintaining the original raw data provides data integrity and ensures no data is lost or corrupted by user action.

Website Data Access

Telogers Enterprise provides a web module that permits sharing the following information to authorized users, via a corporate intranet or the Internet using web browsers:

- Real-time access to data from any flowmeter or measured parameter.
- Access to historic data.
- Real-time and historic flow data access to any defined pseudo site.
- Presentation of up to 10 parameters in one graphic presentation.
- Scattergraphs of any flowmeter site over any time period with Manning function curve overlay.
- Flow data presentation in a choice of statistical formats, e.g., Continuity, Manning, Colbrooke-White, etc.
- Powerful graphic manipulation tools including active cursor, zoom and pan tools, and calendar selections (daily, weekly, monthly, quarterly, annually or custom times).
- Numerical spreadsheet reports exportable in a variety of formats and time periods.
- Site status information, including recorder battery capacity, up-time report, sample rate, call schedule, calibration data, physical parameters, etc.

Client Access Control

Data provided by the *Enterprise* web module is read only; the user has no access to modify the database or any operational system configurations. A *client access control* utility is included with *Enterprise* that permits the system administrator to control data content to authorized parties by user name and password. Client access control permits different permission levels. For example, utility customers gain access to final flow data from flowmeters servicing only their communities, while the utility's management and consultant engineer have higher level permission to view all measurements from all sites.

Telog Data Management Service

Telog provides a Data Management Service (***DMS***) for customers who prefer to outsource the data collection and data management functions. This also reduces the customer's cost and dependence on internal IT personnel and computer resources.

When employing the Telog *DMS*, the customer's remote site recorders will communicate with a host computer at Telog's Data Management Center. Data can be collected and deposited into a client specific SQL database. This data may then be served up on a customer designed web page in reports defined by the customer.

The following diagram illustrates an example of a Telog Data Management System utilizing 1xRTT communications technology over the Verizon packet switched network. In this example, a remote Telog recorder (RTU) is monitoring a wastewater flowmeter in a manhole. The recorder is connected to a Telog antenna buried in the pavement adjacent to the manhole.

The remote RTU collects data from the flowmeter (typically level, velocity and flow computations) at a user defined interval (e.g. 15 minutes) then forwards this data to the Telogers DMS host computer. The communications path begins wirelessly between the burial antenna and a local cell tower, then via the cellular carrier infrastructure and the Internet to the Telogers host. Internet Protocol (IP) addresses within each data packet instructs the network routers where to send each packet.

Administrative controls on the *Enterprise* Server limit access to data to those web site visitors that log on with the appropriate user name and password. DMS customers may provide access rights to their clients to permit them access to information from specific sites, for example a single custody transfer flowmeter.

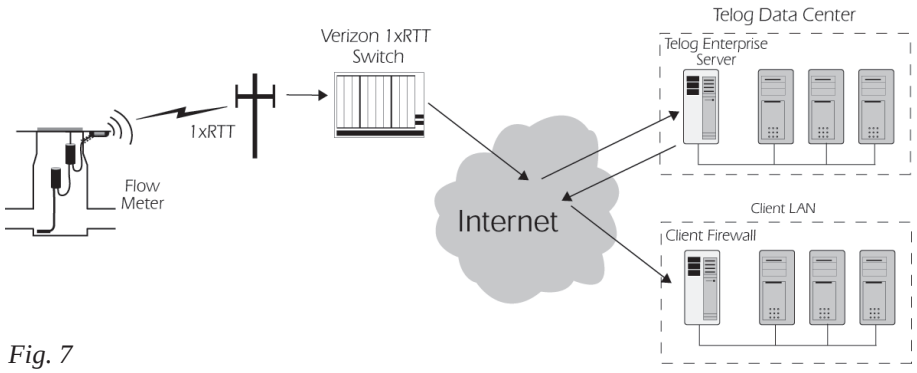


Fig. 7

Flowmeter Interface

Two Interfacing Methods

Telog offers two methods of interfacing popular open-channel flowmeters. The more general approach is to accept the analog outputs, (e.g., 4-20 ma current loops), produced by the flowmeter representing the measured values of velocity, level and flow. Alternatively, the Telog remote RTU can be connected to the flowmeter's communication interface port and the flow-related information collected digitally following each flow measurement.

Telog Works With Many Flow Vendors

Telog has established technical partnering relationships with many of the more popular open-channel flow meter suppliers. These relationships provide Telog access to the proprietary protocol of each flowmeter. Direct digital interrogation of the flowmeter by the Telog remote RTU for flow measures provides better data accuracy, synchronization and much lower site energy consumption than analog monitoring. It also permits the user to communicate directly with the flowmeter vendor's host application software via the Telog communications channel, known as the *pass through* mode.

When using *Direct Digital Data* interrogation of a flowmeter with a Telog remote RTU there are two data collection options. 1) The remote RTU may be configured to either collect data from the flowmeter following each measurement, or 2) a command is sent to the flowmeter to initiate a flow measurement. The second approach permits the Telog remote RTU to change the flow measurement rate based on flow conditions or by direction from the host application software. For example, the user may choose to request that all flowmeters increase their sample rate from every 15 minutes to every 5 or 10 minutes during a wet-weather event. This can be done automatically by Telogers, or by a user command at the server.

Pass-through mode

The Telog remote RTU *pass-through* mode permits a communication session to be established between the host server and the flowmeter. This is used for collecting flowmeter diagnostic information or reconfiguring the flowmeter parameters. *Pass-through* mode is initiated when the operator uses the flowmeter vendor software application to establish a communication session with the remote RTU. In this mode, the recorder is acting as the communication link between the host computer and flowmeter.

Using *pass-through* for communication between the flowmeter and a remote computer requires the following: 1) the address of the Telog remote RTU, (e.g. phone number or IP address), 2) the remote RTU password and 3) a copy of the flowmeter application software.

An example of *pass-through* usage would be a client's consulting engineer or flowmeter service personnel to communicate directly with the flowmeter from any remote site. Collected data would be used for the purpose of calibration or to gather diagnostic information from the meter.

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