North Sea FLOW Measurement Workshop

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Paper 5.2

Flow Measurement Asset Management in the 21st Century

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FLOW MEASUREMENT ASSET MANAGEMENT IN THE 21ST CENTURY

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1.0 Introduction

The world of oil and gas production and distribution is changing rapidly. As increasing numbers of assets chase decreasing reserves the demand for information has never been higher. At the same time personnel capable of analysing and using the data are in decline as energy companies endeavour to reduce their overhead.

This situation demands a solution that makes it easier for asset managers and engineers to access and share information securely regardless of time or location.

The good news is that the network/infrastructure already exists and, furthermore, the technology needed to channel it is already installed on the majority of today's computers and everybody already knows how to use it. It is the web browser.

This paper will discuss the role that the Internet can play in changing the way that assets are managed and the possibilities for improved accuracy, safety and profitability.

2.0 Asset Management and the Internet

Even today, collecting information relating to the everyday running of a production platform can involve trawling through large amounts of paper, logbooks, calibration histories reports, audit trails etc. Traditionally these records have been kept as paper copies and may even have been handwritten. The paper environment is vulnerable; it could be illegible or badly maintained and finding anything is highly dependent on a good filing system. Paper systems can only be stored in one place, creating accessibility issues. For example, on a production platform it may be important that vital information must be kept locally but the remote location restricts other personnel from gaining access to the information.

Electronic systems help to make sense of all the paper and bring order to the task but have tended to be focused around proprietary technology or specialised software that is still limited to local access.

Using today's Internet technologies, data can be made available to anyone who has an interest, providing they have access privileges. It is now possible for technicians and metering engineers, pipeline partners, management and auditors to share this vital information.

Web based technology enables information to be stored centrally but made available globally. Streamlining data availability in this way can enhance site performance and maintain system integrity, leading to improved accuracy, efficiency and safety.

These solutions are not limited to replacing paper and text-based systems. Web-enabled database technology is already having an impact on flow measurement and control system design. Systems can now exploit Internet inspired graphics and communication techniques to take real time data acquisition and control to a new level of performance, reliability and secure accessibility.

The ability to access and analyse data remotely can have a major impact on the cost of managing metrology assets.

3.0 The Internet – A Brief History

The Internet (or ARPAnet as it was then known) was conceived in 1968 by the U.S. Department of Defence as a way of linking research institutions across the United States in order that they could share their computing resources. ARPAnet was specifically designed to allow organizations to interconnect their computers into a mesh-like network that would allow information to be sent using a variety of different routes and allowing it to withstand failure of any point [1].

In 1974 the Transmission Control Protocol/Internet Protocol (TCP/IP) emerged, allowing a system to connect directly to any other system regardless of network topology and anybody to connect to the Internet [2].

When Sir Tim Berners-Lee invented the World Wide Web in 1989 [3], it allowed Internet users to view information regardless of format or the location of content. It made vast quantities of information easily available and helped to establish the Internet, as we know it today.

Since 1995 the Internet has caught everyone's attention. Usage has doubled consistently every year [5] and there are now more than 170 million users accessing over 46 million web sites worldwide [4].

The Internet can now be accessed from almost anywhere in the world. Conventional connection methods such as dialup modems, broadband and wireless (WiFi) can be supplemented with more global access by means of the latest mobile phone and satellite technology.

3.1 Intranet

As well as the publicly available parts of the Internet, many companies have adopted Internet technologies within their own organizations. These private versions of the Internet are known as an Intranet.

Intranets are based on the same TCP/IP networks as the Internet and run the same protocols, including Web and Email, but access to the network is limited to users within the company.

Historically, private Intranets have been almost entirely cable and Ethernet based, however the new prevalence of wireless WiFi networks, (IEEE 802.11g) together with secure Virtual Private Networks (VPN) technology are giving users greater flexibility with regard to Intranet access.

Intranets are particularly useful when used in conjunction with database technologies, enabling users to share information in real time regardless of where the information is stored.

4.0 Web-Enabled Databases

The World Wide Web can be used for much more than just viewing web sites such as eBay and Amazon. Within an Internet environment, web based technology can also allow users to access and interact with database information using just a web browser.

The web browser is the perfect front end for a database. A standard web browser can be used to view and amend database information. A web-enabled database generates standard web pages that can be viewed by any web browser.

A web browser is installed as default on all computers and is the only application that is needed to use a web-enabled database. IT personnel do not have to spend time installing and supporting extra software, database clients, bespoke applications, browser plug-ins or Java. Furthermore, because the web browser is free, there is no requirement to purchase expensive user licenses.

4.1 Access From Anywhere

An authorised user can access a web-enabled database from anywhere in the world with just a web browser and an Internet connection. Users can take advantage of the existing Internet infrastructure to use the database from their desk at work, wirelessly from the meeting room, through a broadband connection at home, and from airports and hotels while overseas. In fact a web-enabled database can be accessed from almost anywhere using a cellular telephone or satellite modem. Never before has data been so readily available and easy to access.

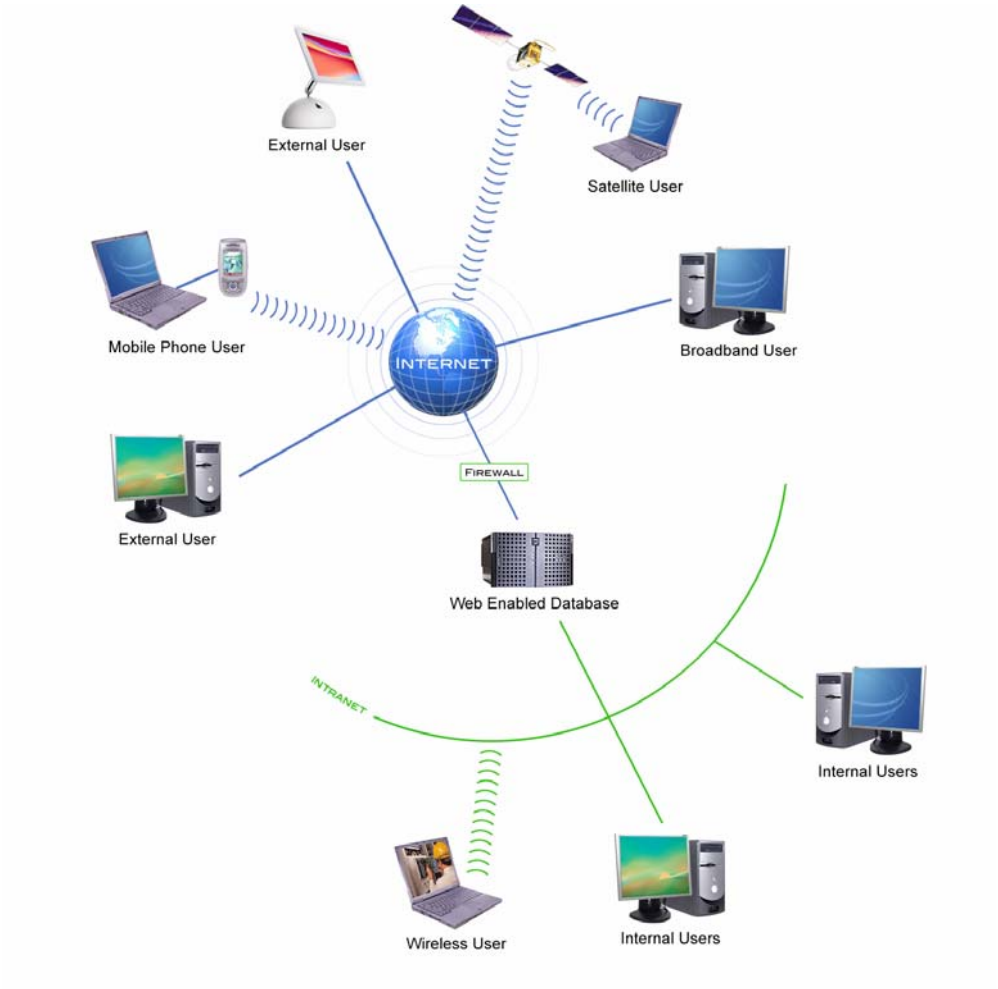


Fig. 1 – Intranet Databases

4.2 Graphical User Interface

The Web is a graphically rich environment that has been designed to serve text and graphics seamlessly. The same graphics can be applied to web-enabled databases, providing them with visually stunning interfaces.

Everyone already knows how to use a browser to access the web and this familiar interface and ease of navigation is carried through to the database. A well-designed interface enables users to interact with data in ways that are not possible with conventional technology, providing personalised content and adapting to the user's requirements.

4.3 Regional Settings

A web-enabled database can be viewed from anywhere in the world, however language can limit communication. Web based systems can overcome this by taking advantage of web based translation services to provide instant translations of the entire interface. Using these services, a Russian user will see the interface in Russian, an English user will see the interface in English and a French user will see it in French etc. The system can also take into account other regional differences, including number and date formats and time zones etc.

4.4 Low Bandwidth Connections

The Internet has been designed for both high and low bandwidth connections and is therefore ideally suited to production platforms, pipelines and other installations that may have limited Internet connectivity.

Well-designed web pages use graphics and text files that are only a few Kilobytes in size. Graphics and resources used repeatedly are cached to help ensure that pages are fast to load over a low bandwidth connection. System performance is also increased by ensuring connections to the server are never kept open longer than necessary. Keeping connections closed when they are not in use also means that there are no real limits to the number of users that the server can support.

A well-designed database site will run almost as fast using a modem as with higher bandwidth technology. Access is almost instantaneous when used on high performance Intranet networks, leased line or broadband connections.

4.5 Email Updates

In some cases the web server will need to communicate with the user in other ways and the most convenient way to do this is using email. Data such as reports, alarms or event notification can be sent via email by the system.

Emails can include database generated reports as attachments in a variety of formats, including Portable Document Format (PDF) files, Excel spreadsheets, Word documents or Extensible Markup Language (XML). The system can also include an integrated mail server that is capable of sending email directly to the recipient's email server and send Small Message Service (SMS) notification directly to the user's mobile phone for instant communication of events.

4.6 Security

Understandably, security is a major concern with the Internet. Stories about hackers gaining access to web-based systems are well documented. However, in reality there are limited types of attack that hackers can attempt and each of these methods can be nullified by web applications that deploy the necessary countermeasures. Well designed web-enabled databases can be made extremely secure.

The industry standard is to use three layers - a database, middleware and a web server - but this approach can be vulnerable.

Better security and maintainability can be achieved by integrating these layers. Installing an integrated application on secure network topologies, implementing its Digest Authentication and Secure Socket Layer (SSL) security protocols and maintaining user accounts outside of the operating system all contribute to an extremely secure environment with no back doors.

Issues relating to Internet security are complex and the subject demands a paper in its own right. This paper has already been written and is available for on-line viewing. [8]

Example – Metrology Logbook

In today's increasingly regulated world, the requirement to formally document the operation and maintenance of complex process plant systems demands no justification. It is of paramount importance that actions and events can be recorded as they occur and shared with others expeditiously.

Electronic logbooks are not new but most are simply digital copies of the paper version. However, by taking advantage of web-enabled database technology and the power of the Internet, continuity of information across time and distance can ensure that key event data is available to all personnel who need to interact with plant and process.

A web-enabled logbook creates an interactive environment where management, operations and technicians can collect and share key information regardless of location. Events and actions are recorded using automated templates, context specific prompts and menus to ease the record keeping process and avoid operator error. Recorded information can be date, time and process data stamped automatically and supported by comments and secure digital signatures as appropriate.

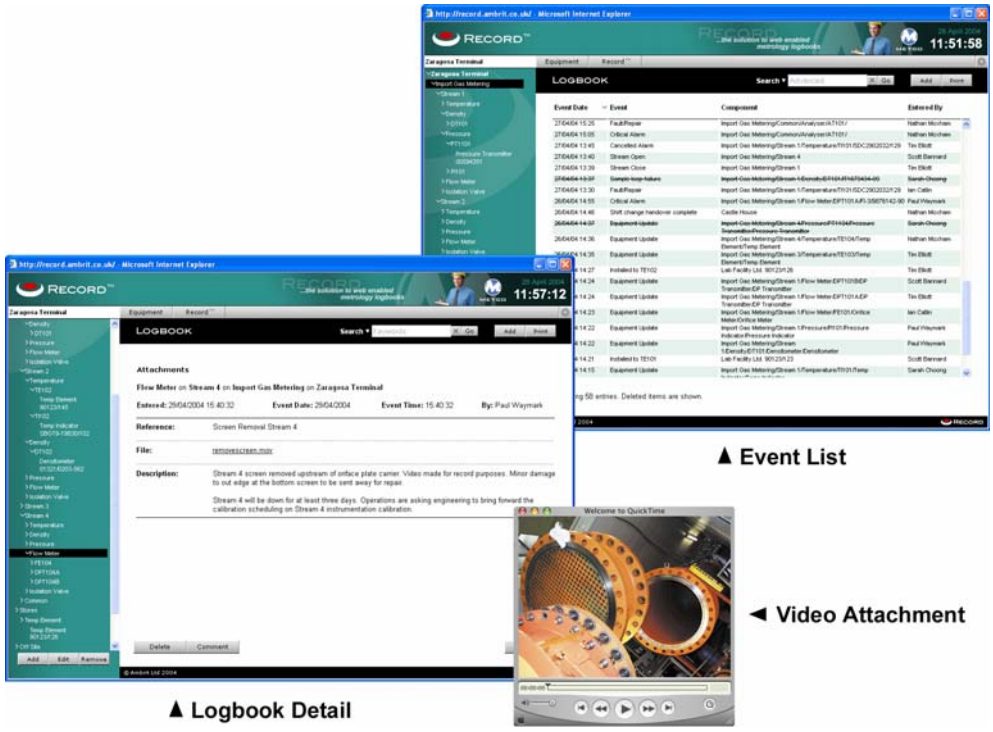


Fig. 2 – Typical Web-Enabled Logbook Pages

Event data can be supplemented with file attachments, including scanned document files, digital photo files, PDF document files and video. These file attachments can be recovered and viewed through the web browser interface.

Sophisticated search tools enable detailed analysis of plant and process records. Reports can be exported automatically to other systems or emailed with attachments in most popular file formats.

The interaction is not limited to manual event entry; web-enabled logbooks can also be updated by other systems. Events detected by measurement and control systems, calibration events and audit events can be entered automatically. Events can be authenticated with date, time and meter readings and interlaced chronologically with the manually entered events. Logbooks implemented like this can provide a concise history when required.

Traditionally, the auditing of metrology systems has always required that an auditor must visit the site. Today, many aspects of the audit can be implemented remotely saving time and expense. Logbook and calibration histories can be easily cross referenced with the findings from previous audits allowing the auditor to pinpoint areas of concern before the audit visit, leading to a better use of valuable time.

The ability to access and analyse data remotely can have a major impact on the cost of managing metrology assets. Travel and accommodation costs and time spent on site can be reduced dramatically. All this increases productivity and efficiency and makes maximum use of a finite number of skilled engineers.

5.0 Example - Metrology Audit Management

The process of implementing a Metrology Audit involves several people at different stages of the auditing process. This includes defining the initial audit criteria, conducting the audit itself, the creation of the audit report and the management of the audit's findings.

The collaboration between a team of people including audit management, administration, auditors, partners and clients reveals the true strength of a web-enabled database by managing the workflow of each audit.

When any audit task requires the attention of a team member, it will prompt them automatically by email. Links to the relevant part of the audit report are embedded in the email, enabling the user to go directly to the task in question.

Users can view the audit by logging on to the web server from their desk using their browser.

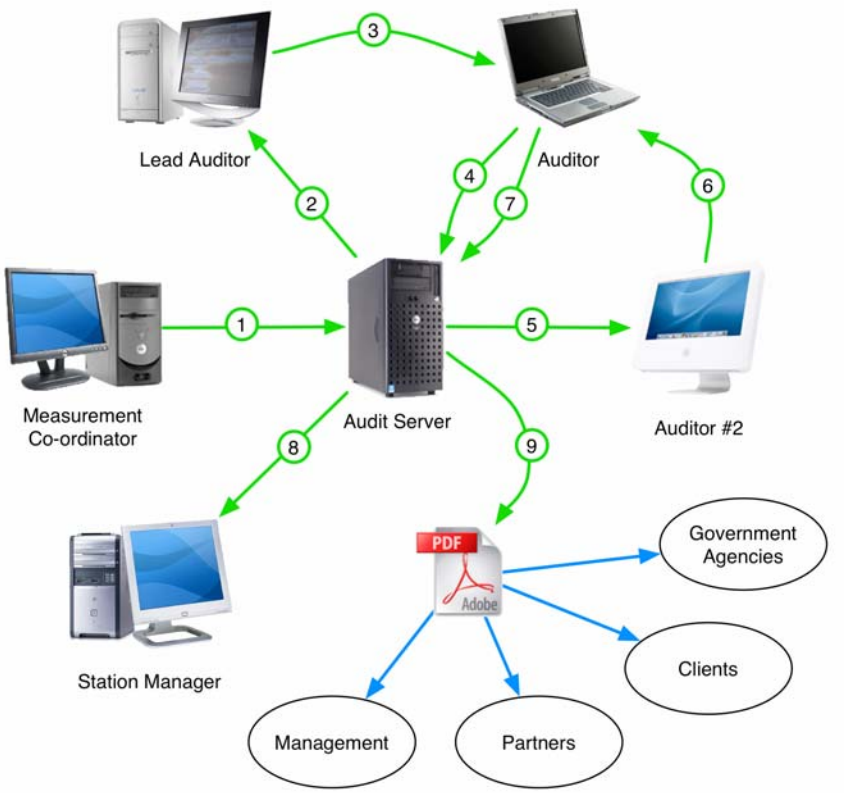


Fig. 3– Collaboration Required in a Typical Audit

1) The measurement co-ordinator liaises with the audit company to set up the audit criteria.

2) The lead auditor within the audit company receives notification that a new audit is required.

3) The lead auditor allocates the audit to one of his team of auditors.

4) The auditor carries out the inspection, gathering the data for the report.

5) A second auditor receives the audit document to check.

6) The second auditor provides comments and a second opinion on the audit report.

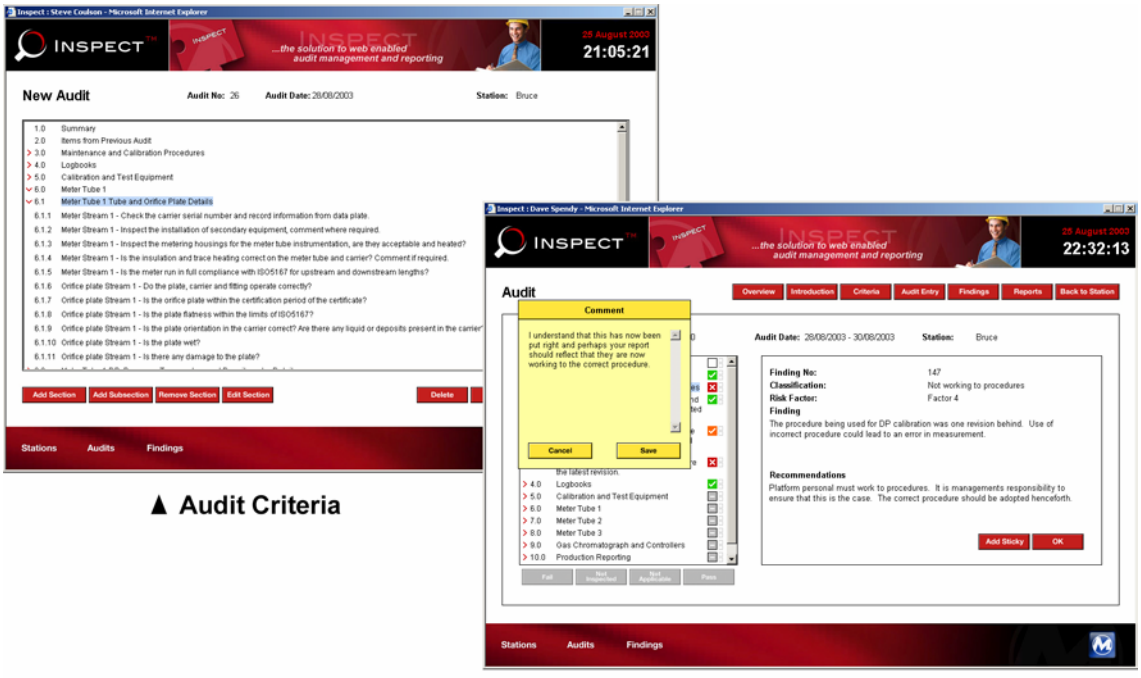
7) The Auditor takes this feedback into consideration and resubmits the document. At this point the report can go to another auditor for rechecking or is published.

8) Once published the station manager has access to the report's findings, which can be addressed on a point-by-point basis.

9) The audit report is output as a PDF document and made available to interested parties; management, partners, clients and government agencies etc.

Conventionally this process would require an extensive paper trail to allow the contributors and interested parties to collaborate. The management of such a complex set of interactions is onerous using conventional paper based data collection.

Web-enabled database technology streamlines this function by providing a paperless, online window into the process and allowing real time interaction. As the audit process continues and the contributors interact, a data file is generated that will eventually form the basis of the finished report. The report is subject to strict revision controls and generated automatically in a preformatted style by the database. The final revision of the report is made available as a PDF document and distributed by the system through email and stored for future online access.



▲ Audit Criteria

▲ Audit Finding Entry Screen

Fig. 4 – Typical Web-Enabled Audit Pages

The audit process data is archived on the system as a historical record of the event. The records can be searched using built in search tools, allowing future users to find key historical information from their desk. The findings can be accessed and used in future audits. As the system grows audit data can by analysed by built in tools to reveal trends in performance. This style of web enabled auditing is already in use today, bringing greater accuracy and efficiency to the metrology audit processes.

6.0 Example - Real Time Data Acquisition and Control

Web based technologies provide superb solutions for the creation of HMI's (Human Machine Interface) for automated systems. Blending graphics and communications capability developed by the Internet industry with modern database technology provides excellent opportunities for creating windows into measurement and control systems.

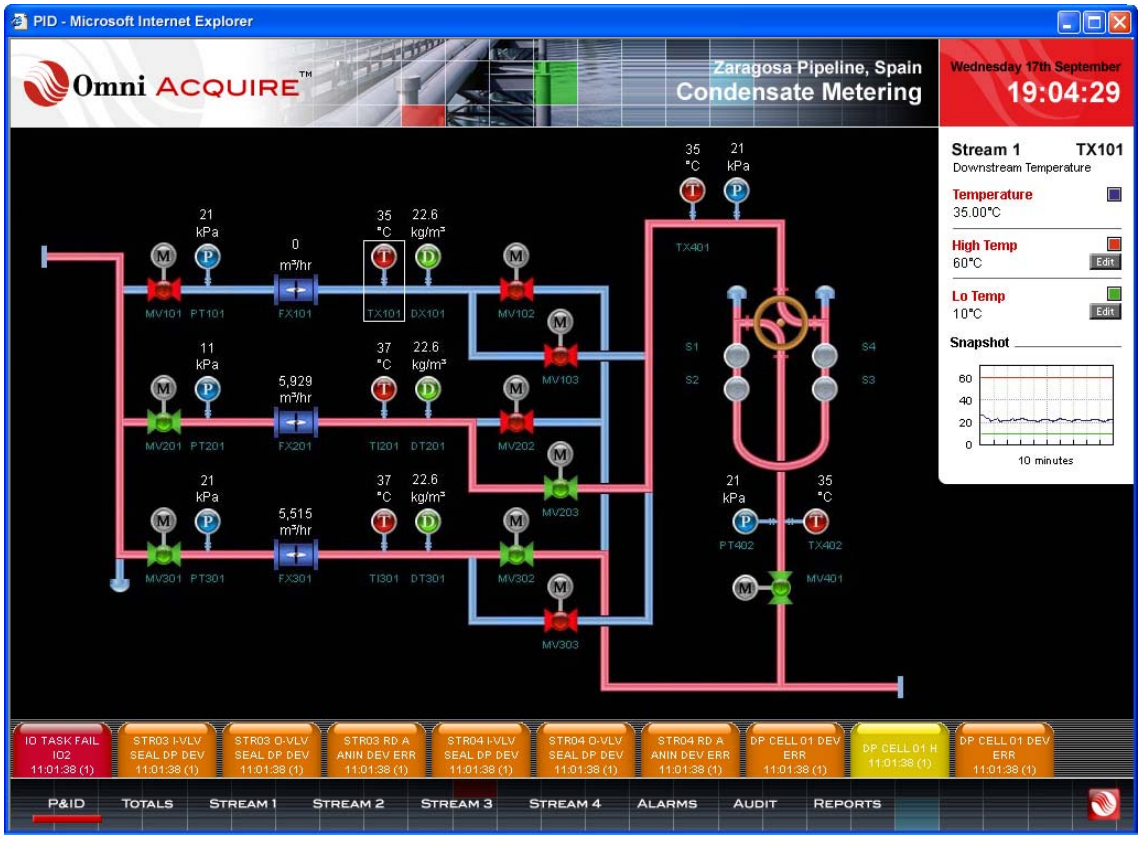


Fig. 5 – A Typical Web Based Control System HMI

A web-enabled control system can benefit from the high quality graphics that the browser offers to provide a stunning interface and access to the navigation techniques associated with a conventional web site. The advanced features of the browser enable the data presented on the pages to be refreshed seamlessly in the background. If only changes to data are sent, this keeps screen refresh data to a minimum and maximises performance, even on slower connections.

Most flow computers, and RTU's communicate with supervisory systems using variants of Modbus or OLE for Process Control (OPC) communications protocols over TCP/IP or serial connections. Real time information is gathered by the web-enabled database which makes it available online.

Local Intranet networks can provide access to HMI information in control room environments and this can be extended throughout the plant to provide access to management and technicians. There is no limit to the number of access points because they are merely web browsers deployed at operator terminals.

Unlike conventional SCADA systems, web-enabled supervisory computers can extend access securely via the Internet. Graphical, interactive mimic diagrams representing plant and instrumentation, process trends, coefficients, alarms, audit trails and historical reports can all be accessed from anywhere using a web browser.

With some software products, the user is not limited to just viewing system data. Users can also interact with the system, controlling process variables and limits, valve control, proving and batch scheduling. Stringent security checks are put in place to restrict unauthorised activity. Web-enabled database applications open up new opportunities for the control of remote processes where security and real time operation is paramount.

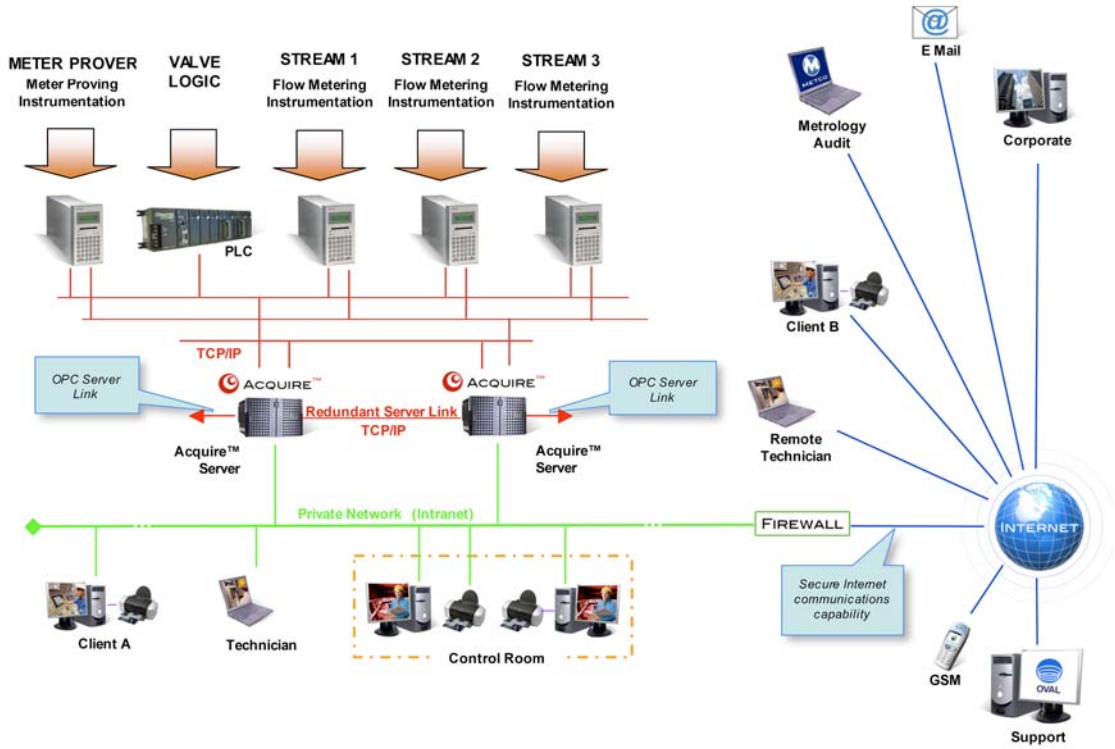


Fig. 6 – Topology of a Typical Web-Based Control System

Data in the form of process, alarm and audit trail reports from flow computer systems can be downloaded at regular intervals and made accessible online for remote users.

Reports can be created and stored as HTML, plain text or converted to PDFs and sent automatically by email. Data is now readily available to operations, management and technicians regardless of geographical location and language preference.

These new technologies can also change the way modern systems are engineered. Gone are the days of software engineers developing systems from scratch. Today complex measurement and control systems benefit from rapid deployment techniques and systems can be built by the metering engineers themselves using drag and drop configuration with no custom software involvement. Systems can be created in minutes, polished and tested, and be available for use in a matter of hours. Systems can be deployed in a considerably shorter time frame, substantially reducing the inherent technical risks associated with customised software.

Web-enabled systems can be supported remotely allowing system integrators to provide assistance without having to go to site. Expert support can access the measurement system from any location all contributing to the low cost of ownership.

A product approach means that systems are no longer vulnerable to changes in hardware, operating systems and browsers as they now can be easily upgraded without affecting the scope of the installation, ensuring that systems remain up to date as technology advances.

Internet technology has a major part to play in the deployment of low cost high performance HMI's in the 21st century.

7.0 Any Where in the World

Imagine running a vast pipeline with many metering stations distributed down it, some of which may be in very remote locations. Previously the only way to access this information was using expensive and slow modem links over hard-wired telephone connections.

Using a combination of the latest Internet and satellite technology real time data can be collected from instrumentation anywhere in the world. It is now possible to connect a satellite or GPRS modem to a flow computer or Remote Terminal Unit (RTU) and use a web-enabled database to collect the information and convey it to designated personnel or company sites via the Internet. All this can be done at a fraction of the cost of conventional solutions.

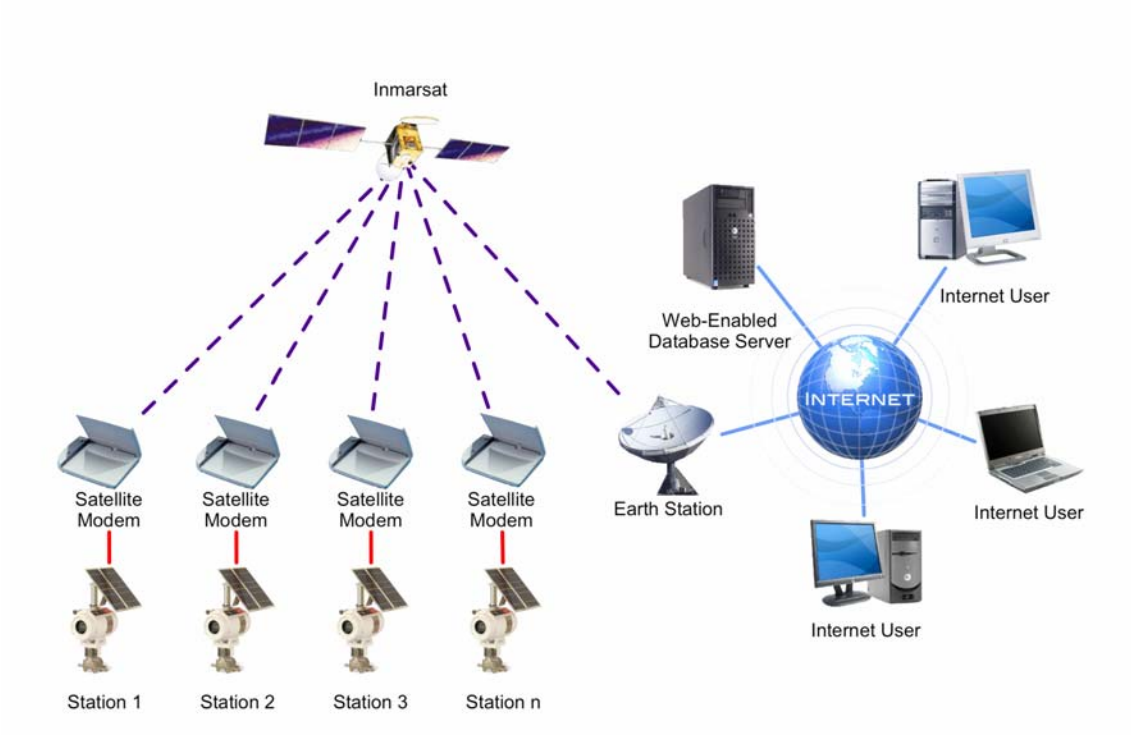


Fig. 7 – Satellite Communications

A web-enabled database can poll each RTU on the system at regular intervals to request its alarm and report data. Having retrieved the data it is stored in the web server's database and can be accessed using a web browser.

Satellite or GPRS connections are always connected, effectively smart wire, but unlike modem connections there is no overhead involved in waiting for the connection to be established. Costs for satellite communications have decreased dramatically and they are now cheaper than using a modem.

This area of communications is growing rapidly. Satellite communications are now at the same stage that mobile phone communications were in the early nineties and will revolutionise communications in the next ten years. Faster, cheaper and more reliable data from literally anywhere in the world will soon be considered *de rigeur*.

These systems are geographically dispersed by definition. A typical pipeline may run over a large region or even several different countries. To speed access to the required information a web portal can be introduced.

A web portal is a web based navigation tool that helps a user locate the information that they are looking for by collating all data into a single place. A portal can start from either a world

wide or local perspective and by using the browser's graphical capabilities the user simply navigates by clicking on the regions of graphical map to zoom into the system they are interested in.
For example, the portal shown below can provide access to a corporation's pipeline system. Starting from a world wide view, the user can zoom in to Europe, then France, and finally to a measurement system at a precise location. From here the user can continue to drill down into the data acquisition and control system and related logbooks, audits, assets etc. The navigation is intuitive and enables rapid access to data in many forms.

Fig.8 – Portal Example

Systems of this kind are not limited to data acquisition and control. For example, they can also maintain world wide inventory records on system equipment, providing the user with a dynamic asset register that can be maintained from each location and shared world wide.

Integrating other web applications, including logbooks, calibration software, system document libraries or auditing software, extends the scope of the portal even further. Collating data in a central inventory database creates a metering focal point that allows metering specialists to evaluate field equipment, test equipment or availability of spares world wide while working at a metering station. Access to logbooks and calibration data, for multiple stations helps senior personnel to spot trends with reliability of equipment.

Concepts like this could not be conceived before the advent of Internet. Today, web-enabled databases can provide low cost, high performance solutions to global data interchange.

8.0 Future Technology

The Internet will get faster and even more useful with the adoption of faster broadband connections and the proliferation of wireless networks. It will become much easier to stay in touch with easy access to the Internet from the next generation mobile phones and Personal Data Assistants (PDAs). Instant messaging, email, voice and video conferencing will become more prevalent and will converge. Soon everyone will start to use these technologies to communicate over the Internet instead of using traditional telephone technology.

At the beginning of the 20th century the telephone was cutting edge and destined to change society and the way we work. It did. With the dawn of the 21st century the telephone communication as we know it is already undergoing revolutionary change fuelled by the Internet.

On the other hand, the World Wide Web has not changed much over the last 10 years and probably is not going to in the coming years. Microsoft has won the browser war and appears to have all but ceased development of its popular Internet Explorer browser. Other web browsers such as Firefox and Safari are starting to emerge and are adopting new standards but with 46 million web sites in the world they will have to ensure that even they remain backwards compatible for the foreseeable future.

Asset management on the Internet will certainly move forward with many new and exciting innovations to come. The framework discussed here shows how information, not readily accessible yesterday, can today be collected, disseminated and visualised through a common interface, the web browser. Although this paper only mentions applications related to equipment, logbooks, calibrations and real time data etc. the range of applications will expand considerably in the future as other modules are developed to extend the capability.

Innovation is only limited by imagination. In the 21st century people and systems will work together, sharing information securely, in real time, smarter and faster as never before.

After all that is what the Internet was created for.

8.1 Information Source

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