Aspects of the Integration of P-NET into Intranet Technologies

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Abstract

One of the most outstanding developments of the recent times can be found in Internet and Intranet technologies. The article describes concepts and aspects of an integration of P-NET into Intranet technologies. It covers the integration of configuration management functions and libraries as well as an integration of data acquisition systems and process information systems using P-NET based solutions. The integration is performed using techniques implemented in VIGO and built-in Intranet services of Microsoft Windows. Prerequisites, methods, solutions, efforts and benefits are discussed from the users' and vendors' points of view.

1. Introduction

One of the most outstanding features of modern process control solutions is the integration of data acquisition systems into real process information systems. Typically, those systems are hierarchical organised, as shown in **Figure 1**. They use appropriate data transport implementations within the layers, that are optimised for the specific demands of the corresponding layers.

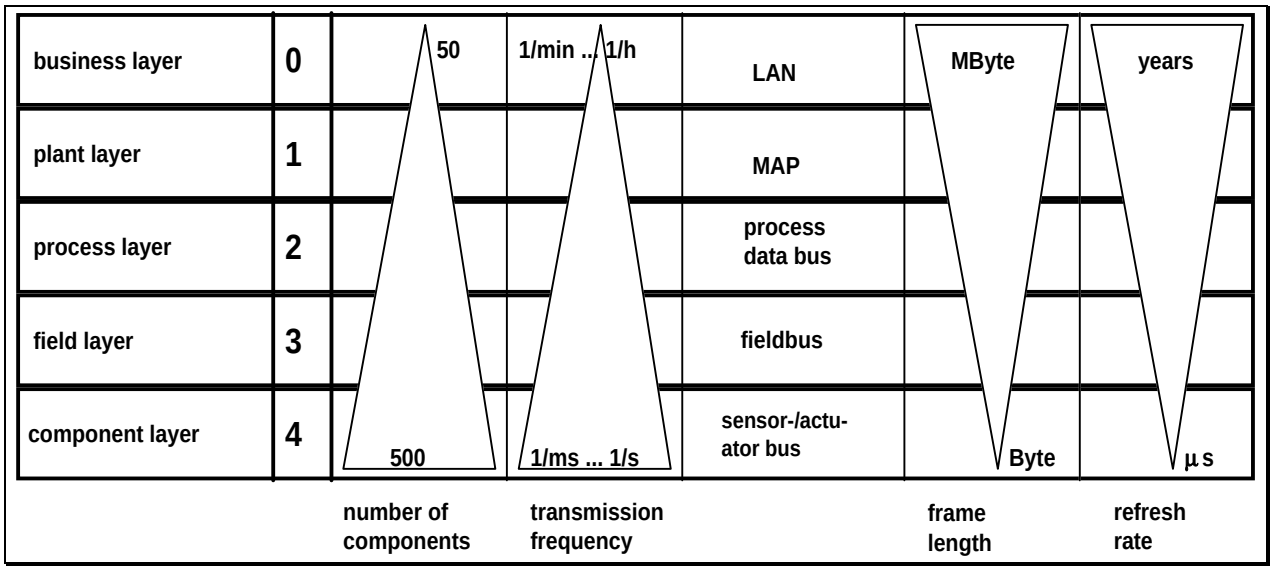

Figure 1: Hierarchical structure of process control systems

In most cases, only parts of the hierarchy are used. So a system may be implemented using a more flat hierarchy, consisting of typically three layers – field management, process management and business management (**Figure 2**) /1/. This reduction is dedicated to the increasing computing power and reliability of modern microcontroller based equipment.

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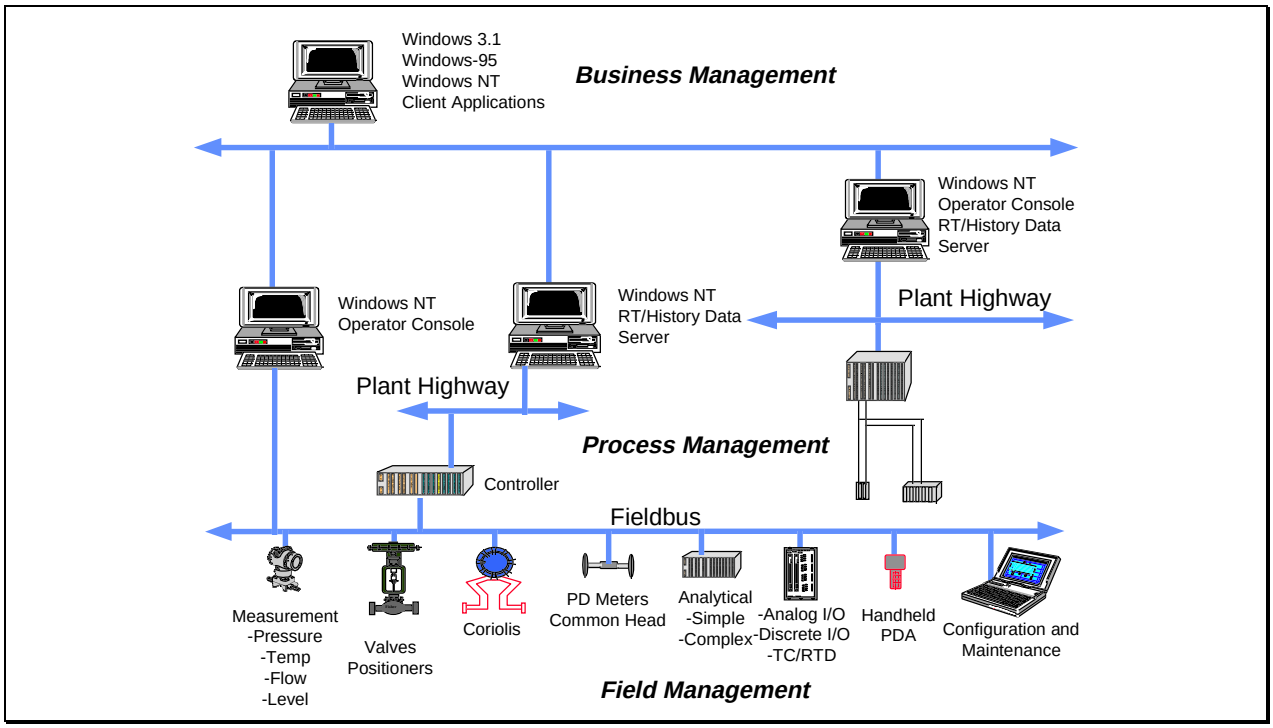

Figure 2: Process Control Information Architecture

In the field management layer, a fieldbus is the most outstanding data transport solution, while common network implementations, derived from LAN's, can be found in the upper layers. The single transport systems are connected together via gateways. Those gateways are PLCs and Controllers, or even PCs, that contain two different interfaces to the transport systems of the upper and lower layer.

The different transport solutions connected via gateways provide the chance of an easy integration of process control data into business applications – the goal of defining different layers. So data acquisition as well as system's management can be performed by means of standardised software packages, such as SCADA and MMI systems, as well as by typical office applications, that represent a de-facto standard in using PCs.

2. Intranets and process control

Dedicated to the globalism in today's business, effective data transport solutions are required to exchange data around the world. So the Internet has become the most outstanding technique for an integration of exchange of data with different contents and an easy to use interface. The number of server implementations is still rapidly growing. The availability of server and browser software for different operating systems is one of the most important reasons for the Internet's usability. The other main reason is the integration of different data sources within compound documents, that can easily be accessed by a browser.

One aspect of the Internet's success is the introduction of its techniques into local computing environments, on top of existing network solutions. Those local data management systems, based on HTTP (HyperText Transfer Protocol), are known as Intranets (**Figure 3**). They provide Internet-like client access to servers containing files, data and compound documents as well as management software and communication programs. The possibility of connecting different servers together allows structured data storage. That means, that data can be distributed to specialised servers (e.g. database servers, communication servers, document servers), without the browser or

the client taking note of that. So data can be organised in an effective way, while they are accessible transparently from a single client or browser.

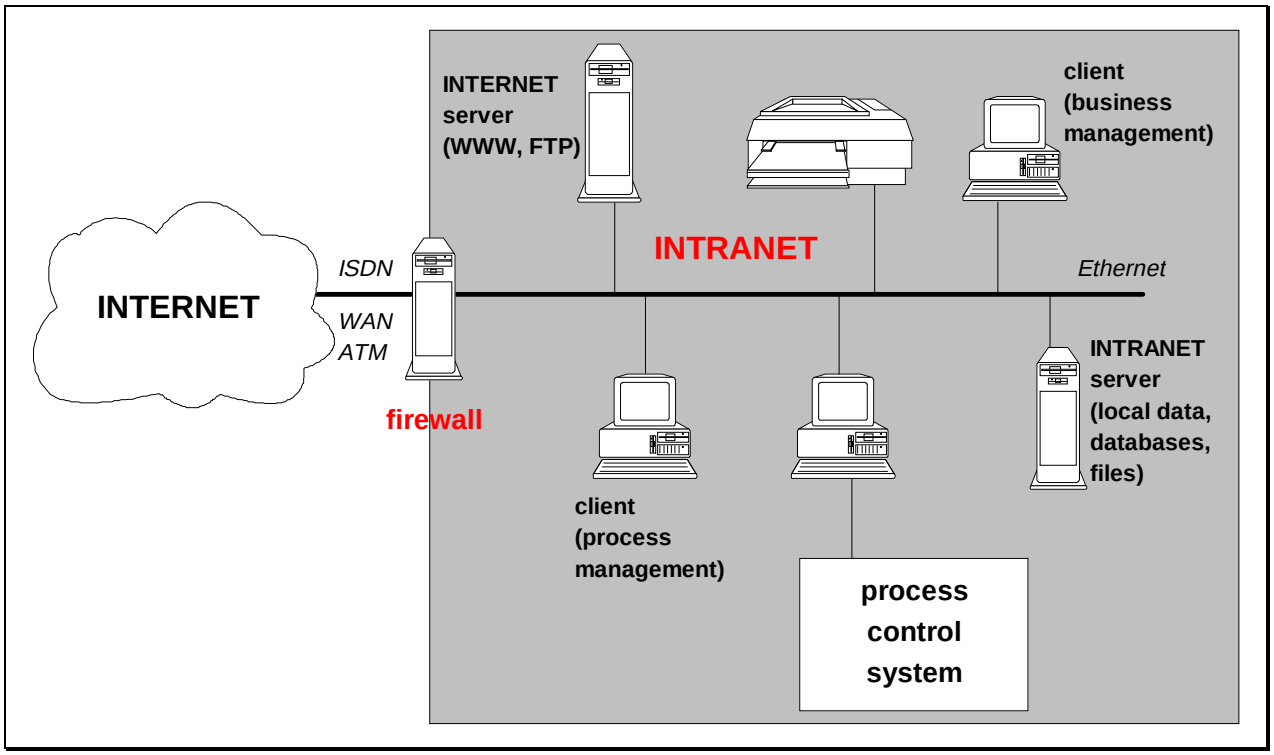

Figure 3: Intranet and Internet

The integration of process control data into a business system can be performed using the described Intranet technology. A specialised data access server can be established, containing the necessary hard- and software to provide the access paths to the process control data.

It is important to notice, that there are different objectives in process information systems and process control systems. While the term “process control system” describes a system with real-time capabilities used to implement the control software for a specific automation solution, a “process information system” covers – at least in the moment – a system with capabilities of non-real-time data access and with management function, integrating the process control system’s (user-)interfaces into business solutions (**Figure 4**).

As Intranets use common LANs for data transfer, they can’t provide real-time capabilities. So they can’t be used for process control systems, but provide best-suited solutions for implementing process information systems. However, there are trends to be recognised in the future, providing life audio and life video transmissions, that may be used to establish real-time capable systems.

3. Concepts of an integration of P-NET into Intranets

3.1. Prerequisites

There are some special prerequisites to be considered for an integration of P-NET into Intranets. First of all, the goals of the integration process have to be reviewed. As mentioned above, the integration is not performed in order to include a business network into real-time process control. The objective is to provide access for business systems with applications like databases, spreadsheets and documentation software to data from P-NET systems, in addition to existing SCADA and MMI packages.

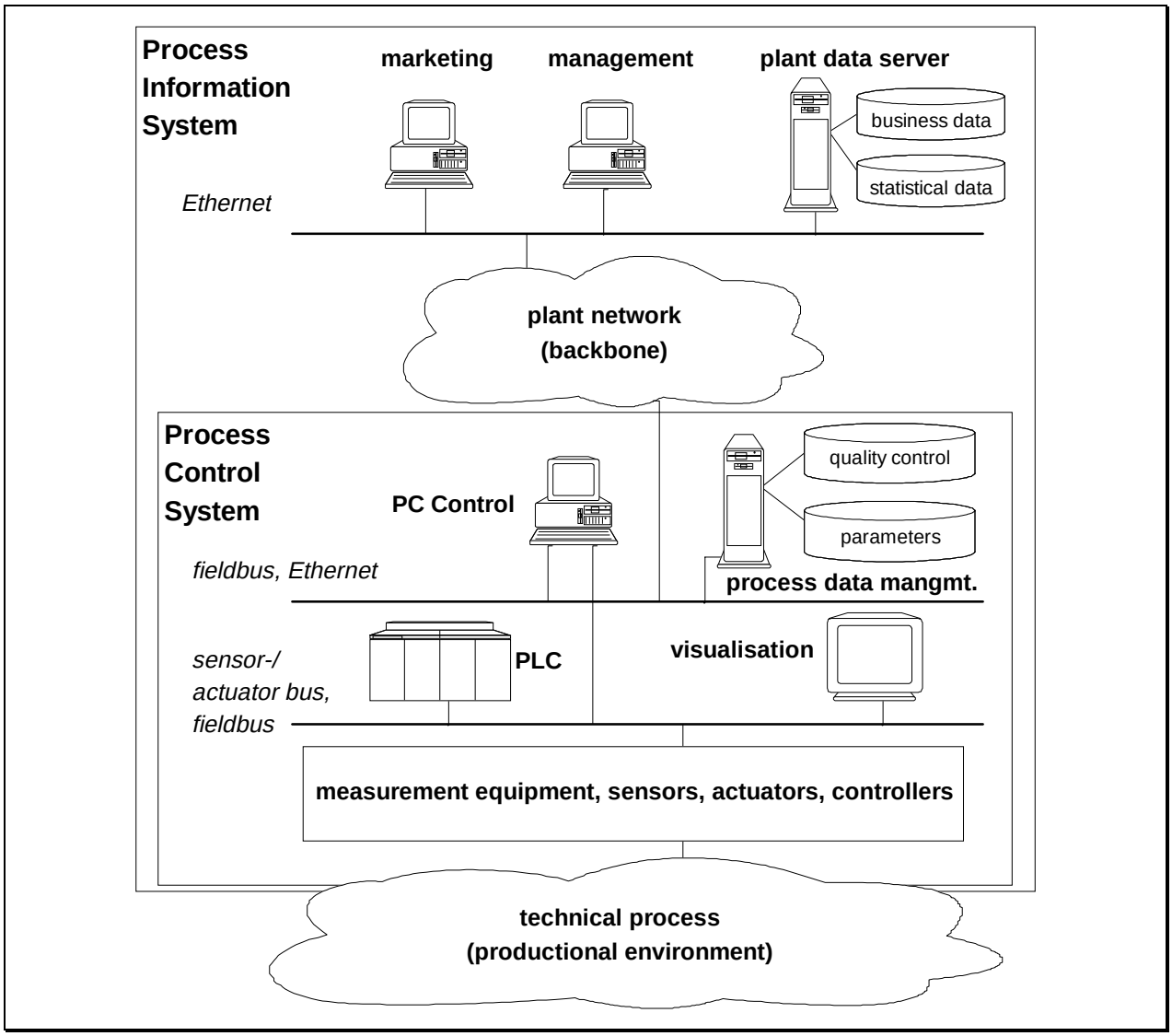

Figure 4: Process control systems and process information systems

P-NET systems are coupled to a PC by means of a P-NET interface card and specific software drivers. So far P-NET does not significantly differ from other fieldbus solutions. A new quality of data access for P-NET is provided by the introduction of VIGO /2/, an OLE based interface /3/ for real-time systems. As VIGO itself is based on the HUGO2 communicating kernel, it is independent of the fieldbus system used – as long as there is a HUGO driver for the fieldbus. So an integration of VIGO will provide a more common solution for the integration.

On the other hand, VIGO itself uses techniques defined in the COM definition of Microsoft. VIGO provides OLE automation access to real-time data, as well as a reusable component for management tasks – the MIBOCX control. Because the Internet applications are build up based on that COM definitions, VIGO offers very good prerequisites to perform the integration process.

VIGO is designed to be used with 32-bit Windows environments, such as Windows 95 or Windows NT. It will not run in the moment under UNIX environments. For the integration process this is not a problem, because there are a lot of server applications available for Windows systems. The integration of a P-NET information server into an intranet overcomes the operating systems boundaries and will lead to a continuous solution for a process information system for P-NET based automation solutions.

3.2. Integration scenarios

As discussed above, a P-NET card implemented in a PC (a standard Desktop PC as well as an IPC) and an appropriate software driver – VIGO – represent the basic equipment. This combination has to be connected to the Intranet by means of a gateway (**Figure 5**). As VIGO offers the possibility to connect an application using VIGO over an IPX network, the gateway can be located on a PC without a P-NET interface card. Such a solution is to prefer, if the PC with the interface card is integrated into process control, for example with an implemented batch controller or a by other PC control solutions.

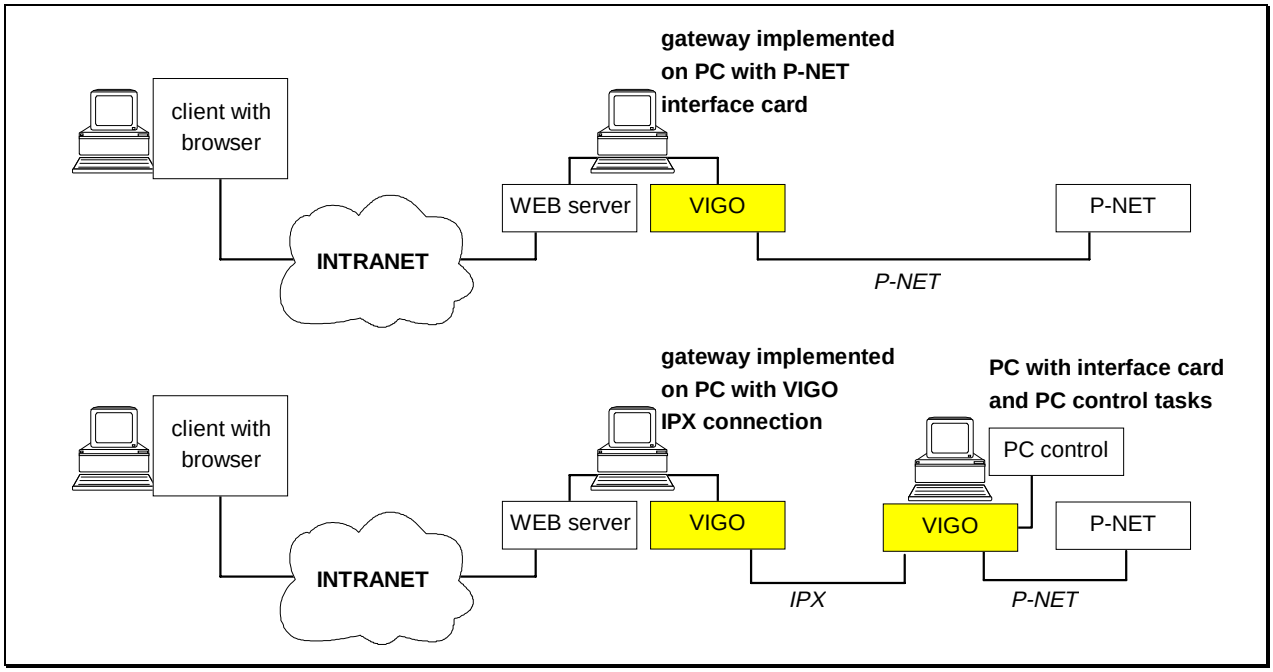

Figure 5: Scenarios of the integration process

The gateway software between the Intranet's HTTP protocol and the P-NET using VIGO has to be implemented as an extension to a HTTP-server running on that PC. Therefor different solutions can be used, that are described later. The gateway initiates P-NET transactions on requests of the clients or controlled by a timer object. The P-NET data access is performed by using the OLE automation interface of a VIGO object. So the integration of data acquisition can be easily performed by following the ideas behind the term component software, which means re-using previously developed software solutions from different vendors. Another way to achieve a data acquisition solution is the use of the OPC data object /4/, that provides access to process control equipment via the OPC interface. Like VIGO, OPC offers connectivity to a broad palette of process control solutions as well as to SCADA, MMI or PC control applications. Using OPC is a good choice, when other OPC applications are required.

Besides the data acquisition tasks, the integration of management functions has to be performed by the gateway. While there are other solutions for data acquisition with OPC or the core VIGO support using OLE interfaces, the integration of the management is an outstanding example for the features of Intranet support. Using a standard Internet browser, management of P-NET systems can be performed. Therefor compound documents are used, containing data of different types and from different sources. So a problem-dependent configuration interface using the MIBOCX control, a data display using VIGO or OPC data objects and additional text can be constructed, additionally containing documentation in PDF format, sample download links and supporting pictures, animations or videos. **Figure 6** shows such an compound document. These documents, with sources distributed in a network or even a global information system, appear as a new quality of process control and of fieldbus management.

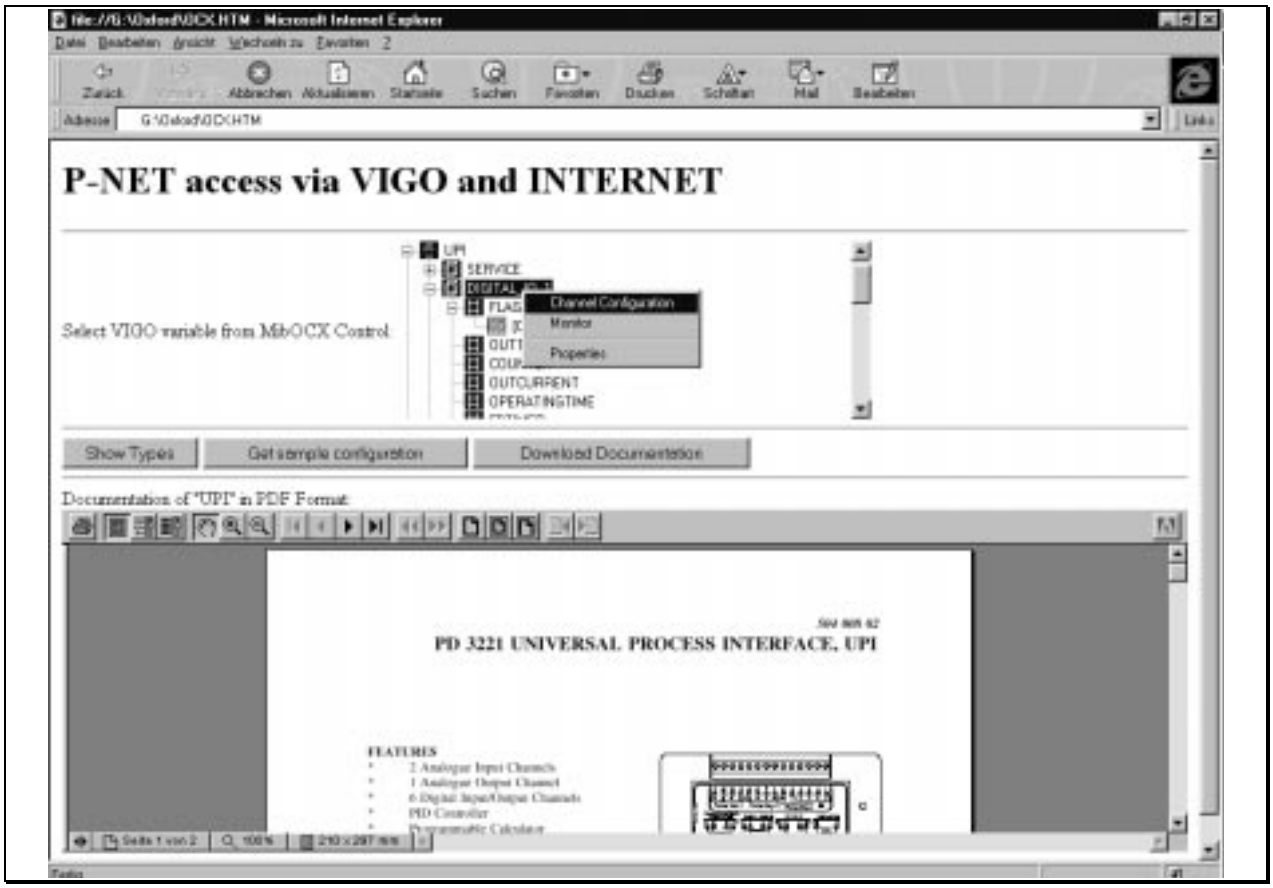

Figure 6: Management of a P-NET system using compound documents in a browser

4. Exemplary Solutions

4.1. Data acquisition using VBScript

Microsoft's VBScript /5/ is a version of the popular Visual Basic, that is adapted to be used as a scripting language in combination with specific server extensions. It is as easy to handle as Visual Basic and combines the features of that language with the popularity of the HTTP protocol. Visual Basic scripts run at the server or the client. However, they require the existence of Microsoft's Active Server Pages (ASP) /6/. The script itself is a text file, containing raw HTML statements and VBScript statements included within special tokens. **Figure 7** shows an example for a data acquisition script designed to run at the server.

```
<SCRIPT LANGUAGE=VBScript RUNAT=Server>
</SCRIPT>
<HTML>
<HEAD><TITLE>P-NET data request</TITLE></HEAD>
<BODY>
<%
set ad = createObject("VIGO")
ad.PhysID = "Universalmodul.ANALOG_IN_1.ANALOGIN"
a=ad.ExFloat
%>
<H2>P-NET Data Request</H2>
<P>
Knopf drücken zur Aktualisierung:
<FORM METHOD="POST" ACTION="readval.asp">
<P>PhysID: <% = ad.physid %><P>
Variablenwert: <% =a %>
<P><INPUT TYPE=SUBMIT>
</FORM>
<% set ad = nothing %>
</BODY>
</HTML>
```

Figure 7: Example for a VBScript based data acquisition document

The server has to be implemented whether as Internet Information Server (IIS), that comes with Windows NT 4.0, or as Personal Web Server running on Windows 95. Both servers allow the implementation of server extensions, in this case Active Server Pages (ASP). The server is located at the PC acting as a gateway to P-NET. **Figure 8** gives a short topological view to the implementation of the data acquisition example, while **Figure 9** shows the document opened with the client's browser windows..

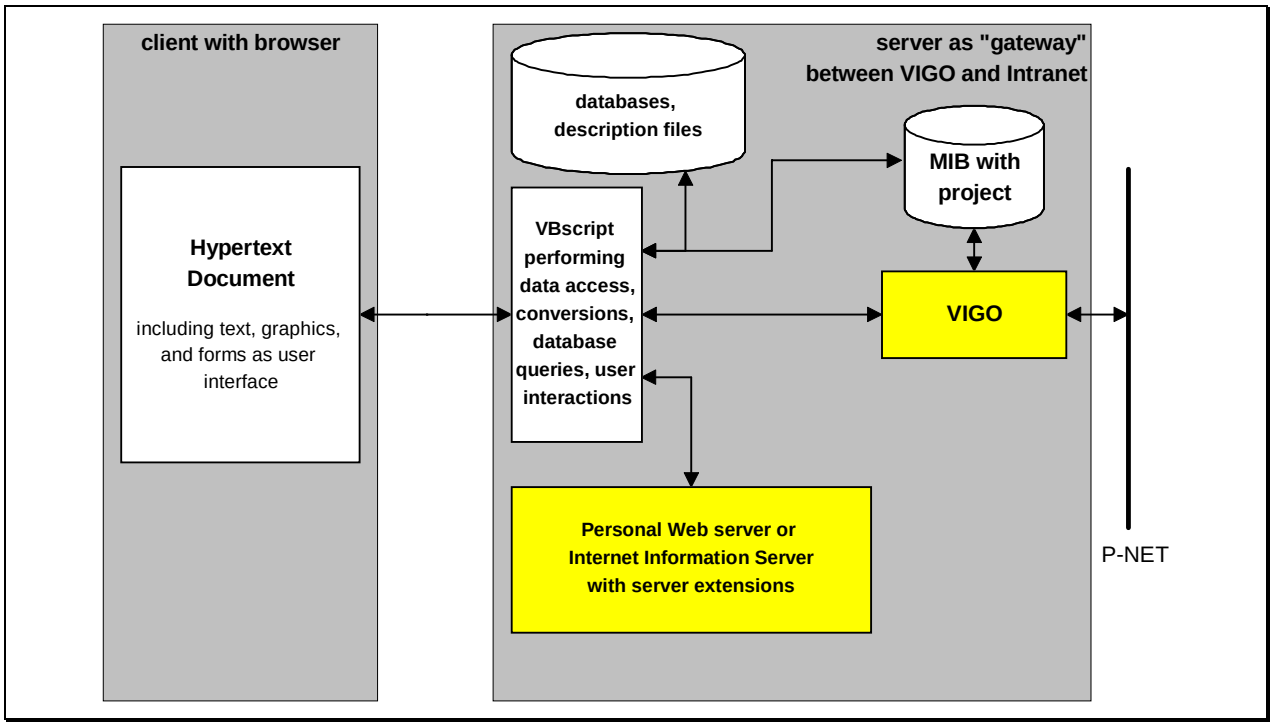

Figure 8: Topological structure of the data acquisition example

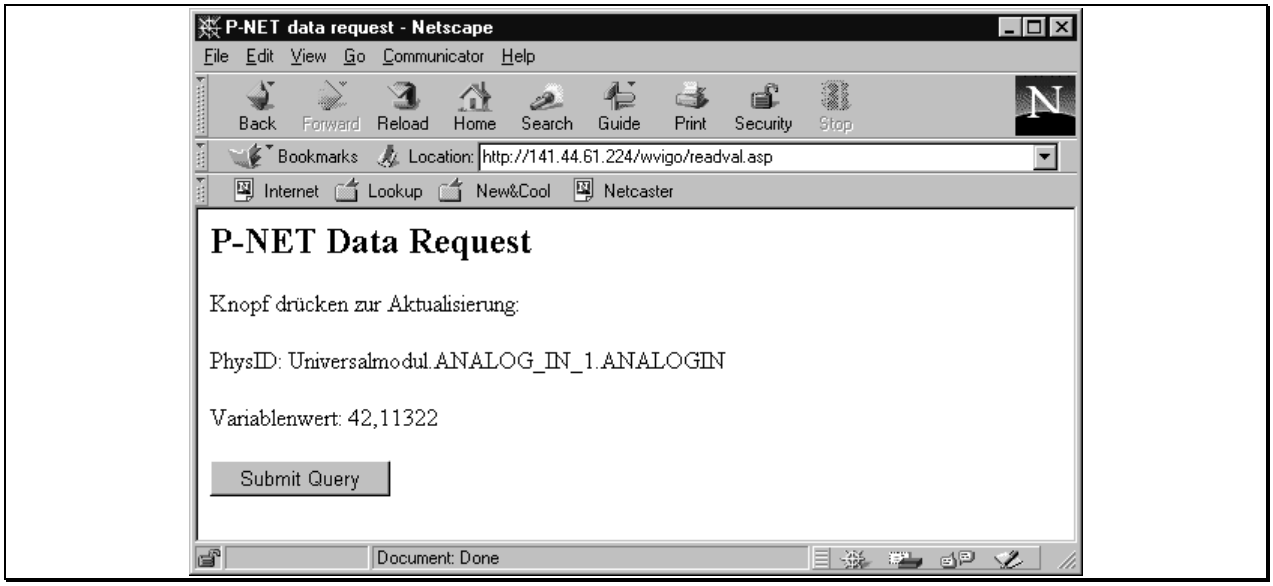

Figure 9: Screenshot of a VBScript created HTML document

The P-NET data access is performed via using a VIGO object within the VBScript page. This is as easy as in standard Visual Basic. The object is created, a PhysId is assigned and then it is ready to serve a VIGO variable. The results of a VIGO read request are converted to a string and then put out to HTML text. The corresponding way write requests are handled. Depending on the data type, a conversion from string into the correct type is performed, and then the data are transferred to the VIGO object. The P-NET requests are stimulated by user interaction (read request of

the VBScript over the network), or can be timer controlled. As many PC-based Internet solutions are based on ActiveX-components (former OCX controls) /7/, there are timer objects, that can be accessed using the same way in VBScript. In addition, as scripts can be executed at the server or the client, the timer control may reside on the client's PC and send requests periodically. The other way is to transmit a timer value to the server and to establish the timer object remotely.

Creating and destroying the VIGO object by the script can be handled in different ways. The simple method is to create the object, perform a transaction and destroy it during a single request from a client. Another way is to provide scripts that create the object, others to use it and scripts for destroying the object after successful use or for error handling. Multiple VIGO objects for simultaneous data access can be handled in the same way. VBScript supports user interface declarations based on forms. So the values read from P-NET may be displayed using forms, the same is possible for values, that have to be written to P-NET. A button or a check box can be used to generate the write data. In the same way the VIGO object itself is inserted by the script, other ActiveX or OCX controls can be used. So the data can be transferred to these objects, and then can be displayed as graphs, gauges, picture and so on, or they can be stored into distributed databases by SQL or ODBC statements.

A very interesting control is the MIBOCX control, that also can be inserted into a script (**Figure 6**). Using that control, a connection to the MIB (Manager Information Base) and a VIGO project can be established. For example, the control may be used to select a PhysId for the following request to P-NET using a VIGO object. Of course all the programs assigned to the context menu, for example the channel configuration or download utilities, will be accessible. As the MIBOCX control was not developed for DCOM, in the moment it is only working properly when called from a browser on the gateway machine. Further development should provide solutions for DCOM, as well as for handling requests for the control downloading over the net.

4.2. P-NET management from Internet Explorer

As mentioned above, the new quality of management systems in process control consists of using compound documents featuring different aspects of the management tasks. The browser as an integrating instance provides a continuous, world wide accepted user interface. This user interface presents different data with different structure and meaning, derived from different sources, in a unique manner using the standardised handling concept of forms and dialogs defined in the Windows environment (**Figure 6**).

In VIGO, management tools are based on a project. The tools are concentrated around the Manager Information Base (MIB) /8/, that hosts the global definitions, like channels and modules, as well as the specific automation solution, the project. An Intranet based management tool should be a part of this group of applications around the MIB (**Figure 10**).

Management in P-NET covers the definition of projects, the assignment of initial values to softwire numbers, the configuration of channels, the handling of controllers. These tasks can be performed using the MIB Editor and the additional tools, that can be executed from the context menu of the editor. As discussed above, VIGO offers an OLE automation object and reusable controls. The MIBOCX control is the most important one. Inserted into an HTML document, it enables a client to access a VIGO project, that currently has to be located at the same PC. So far, in the moment, a remote management is only possible on a gateway PC. However, this PC can use an IPX link to the PC with the physical interface card (**Figure 5**).

Based on the MIBOCX control, a compound document may contain links to other data. Without any special efforts online documentation is insertable. These files in P-NET exist in Acrobat PDF format, which became the standard format for documentation exchange. Using the PDF viewer

ActiveX control, these files can be inserted into an HTML document. Traditionally, pictures, sounds and other multimedia components are insertable into the compound documents. Using the visual tools like MS FrontPage the development of HTML documents with all the links becomes as easy as writing text.

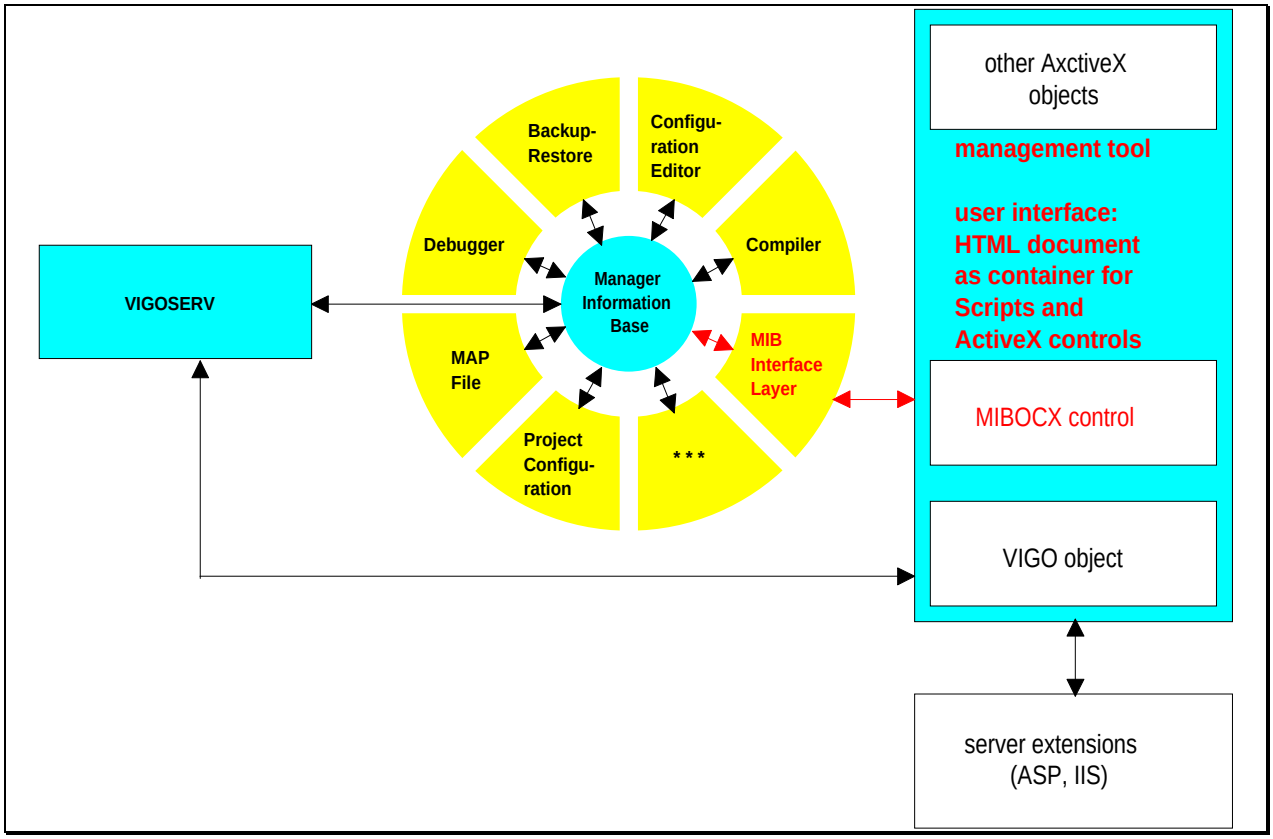

Figure 10: Intranet based management tool and the MIB

A very important role in Intranet technology play scripts and ActiveX controls /9/. The new visual programmer's environments like Visual Basic 5.0 and CCE (Control Creation Edition), Visual C++, Delphi 3 or Visual J++ provide support in writing scripts and owner specific ActiveX controls. These controls can be built up from scratch or may reuse existing controls by aggregation. So the ideas behind the COM/DCOM specifications will help to reduce the efforts in development of user specific software solutions. An integrated download management enables the electronically distribution of controls. They will be downloaded automatically on demand. The download management provides version control and enhanced security using digital signatures. In addition, the license management enables the developers to decide, whether to freely distribute their software or to require license fees. However, the installation of the control is performed automatically, without user interaction. This guarantees a proper installation and a fully functional control.

Using those controls for database access, graphical tools, syntax checkers, documentation management or even compiler front-ends in correspondence with the VIGO object and the MIBOCX control or OPC data objects from a browser showing a compound document as a shell will be the standardised management environment in the future. In addition, the ongoing developments in the area of Internet security will provide effective methods for remote management – from all over the world.

4.3. JAVA support for VIGO

One of the last years‘ most important developments is JAVA. Initiated by Sun Microsystems, the programming language combines the popularity of C++ and the success of the Internet in order to develop operating system independent applications. Nearly every operating system provides virtual JAVA machines, that perform the necessary bindings of a JAVA applet to the client’s operating system services.

The virtual machine provided by Microsoft is able to use OLE objects. So it provides a good starting point for the development of VIGO-related JAVA objects, that allow data transfer to P-NET systems and MIB-based management of such an installation. These JAVA objects are currently under development using MS Visual J++. The topological structure of a VIGO system with JAVA support follows those shown in **Figure 5**.

5. Summary

The integration of P-NET systems into Intranet technologies is performed based on VIGO. That enables data acquisition using VIGO objects as well as management tools‘ access to the MIB project files. The built-in OLE/COM structure of VIGO allows easy integration into OLE and ActiveX capable scripts.

Intranet integration won’t provide a real-time control system, but offers solutions for data access and management in order to integrate P-NET installations into process information systems. This integration also can be done using the native OLE support of VIGO. However, such a solution does not offer the Intranet and Internet technology features to developers and users.

The users participate from the integrative features of Internet browsers, allowing a single application to act as a homogeneous shell, a user interface, to compound documents containing heterogeneous data derived from distributed systems. The growing number of reusable ActiveX components with included download and security methods makes it easy for the customers, to create a user specific environment without having to know specific details of the current installation’s components. The existing networking environment can be integrated. This will reduce installation costs, and efforts for training and preparation. The most important fact seems to be the use of the compound documents with access to world-wide resources.

The developers‘ benefits of that integration into Intranets are reductions in software developments. This is dedicated to the use of controls and their development, allowing to reuse previously written code or third-party solutions. The independence of the operating systems, provided by JAVA and the HTML definitions, will reduce the development efforts. The new methods in software support over the net will enhance versioning and license management. In addition, the short contacts to the user will provide improved support and enables the developer to reduce the reaction times to users‘ demands.

The growing developments in the Internet area and the increasing use of Intranets offer a good starting platform towards well supported, user-friendly, integrative and unique user interfaces to fieldbusses and will help to increase their acceptance.

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