PROFINEWS

PROFI® **BUS** PROCESS FIELD BUS

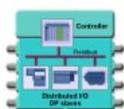| in this issue | Official Newsletter of PROFIBUS International | www.profibus.com |

PROFInet Special:

This special issue of PROFInews is focused on PROFInet, the Ethernet-based automation solution that promises to be one of the most exciting developments in manufacturing automation for many years. PROFInet has taken a long time to reach fruition but its breadth and scope is all the better for it. It offers a completely fresh approach to the challenges faced by manufacturers today. In this issue we explain the 'big picture' and show how you can join the PROFInet community.

CONTENTS

(For your convenience we have linked the above headlines to their respective pages. Just click the 'hot spot')

PROFInet: A COMPLETELY FRESH LOOK AT AUTOMATION

By Edgar Kuester, Chairman, PROFIBUS International

When PROFInet was first 'invented' in 2000 the fieldbus world was coming to terms with 'Industrial Ethernet'. Many people rightly saw Ethernet as part of the future and the rush to integrate fieldbus protocols with the TCP/IP stack was on. The dynamics were understandable - automation was increasingly becoming a part of the 'enterprise' so integration with IT departments was an obvious step.

Today, many fieldbus organizations offer a solution that allows Ethernet to fit in with the fieldbus world. Some changes have been made - physical ruggedness is clearly an important difference - and additional technologies now meet the special needs of automation - for example covering determinism and high security.

Ethernet is running successfully in many thousands of automation applications and - if the researchers are to be believed - usage of Industrial Ethernet will grow at the field level by colossal proportions in coming years.

But as we listened to customer's needs, and thought more about the implications of managing a modern business, we began to realize that a lot more than just Ethernet was involved. A deeper look into automation shows that dramatic changes have been taking place as manufacturers struggle to build profits and remain competitive. Staffing levels are constantly driven down, training budgets are hard hit, maintenance (or, more precisely, its companion 'asset management' or 'plant optimization') have become key issues. Meanwhile, engineering costs threaten to go sky high and everyone seeks new ways to squeeze the last penny out of their investments. At the same time, distributed automation systems are becoming more prevalent and interoperability has become a major issue. Integration with higher level IT systems has also become an essential part of automation, with the Internet presenting many new ways of doing business.

Of course Ethernet has a primary role to play. But the paradigm shift cannot be addressed by a communication protocol alone. What's needed is a way of bringing together all the available 'enabling technologies' in a new package. Fieldbuses, Ethernet, industrial standards such as OPC and a wealth of Web Services must be brought together in a fresh approach that addresses the real needs - manufacturers want to be free to focus on what really adds value - designing, developing and marketing best-in-class products - whilst manufacturing must become more flexible, less costly, less dependent on 'black magic' and far more reliable and manageable.

To meet these needs automation has to offer a holistic solution. It has to become more sophisticated and enterprise-friendly. It must lower costs and be easier to use, it must be more reliable and interoperable. Above all it must provide support for legacy systems - thereby protecting investments - plus migration opportunities for everyone.

That may not have been our starting point for PROFInet in 2000. But if you asked me now to summarise PROFInet I'd answer: "It's a strategy and architecture for the future of manufacturing automation, drawing together all the best open standard technology available today." To see if you agree - read on.

ENGINEERING WITH OBJECTS
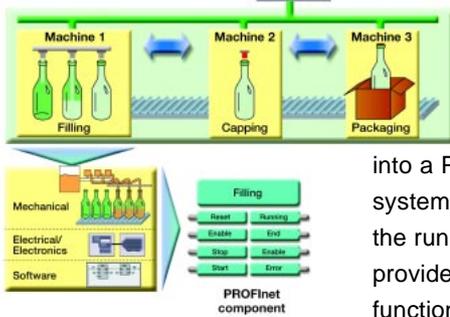
'Object Oriented' techniques are widely used in the software industry though most of the time we don't see them. PROFInet introduces 'objects' into the automation domain where they can be called 'components'. A component can be more or less anything - a boiler, a conveyor or a complete manufacturing cell, though in reality only those that are 'autonomous automation units' can sensibly be one. How this is implemented is one of the keys to PROFInet.

COMPUTER AIDED CONNECTIVITY

Once described, a component is treated as a graphical 'black box' with clearly defined interface points that can be coded into
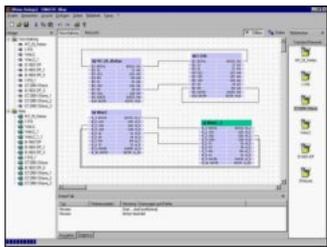
software using PROFInet tools and then displayed in the Connection Editor, as graphical objects. The components can then be

linked by drawing lines to represent their communication relationships. No programming or configuration is required. Proven components are then downloaded into a PROFInet automation system, where they work with the run time software to provide the required functionality. Commissioning takes very little time.

QUALITY, FLEXIBILITY, RELIABILITY

Components can be re-used, so software quality is better and each subsequent task becomes far quicker to implement and therefore less costly. The component element of PROFInet and the standardized interface mean that components from different manufacturers work together easily. Components are certified by PROFInet Test Labs to ensure this.

THREE PERFORMANCE LEVELS

Standard Ethernet TCP/IP is the protocol on which PROFInet is based. So networks will work over any existing infrastructure. In addition, two real time extensions of PROFInet are under development - a Software Real Time (SRT) extension for typical automation applications, with a response time in the order of 5 msec, and a hardware based extension called Isochronous Real Time (IRT) for cycle times of 1 msec and a jitter of 1 µsec maximum.

The SRT solution will be available end of July 2003

STANDARDIZED STRUCTURES

The requirements of cabling are similar to those of PROFIBUS but significantly different from office applications. For example RJ45 connectors must be protected to IP20 or better, depending on the environment. The PROFInet specifications fully define what infrastructures are possible and how to implement them.

## INTEGRATION OF FIELDBUS SYSTEMS

Any existing PROFIBUS network (or any fieldbus in fact) can
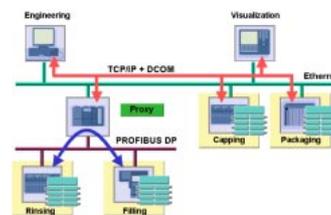
interoperate with PROFInet using a Proxy. Fieldbus networks can also be created as a PROFInet component to fit directly into a PROFInet system. Which is used will depend on individual situations.

DE-CENTRALIZED FIELD DEVICES ON ETHERNET

In many applications, a conventional PROFIBUS network will still be the best solution for connecting de-centralized devices. However, more and more users are asking for direct connection to Ethernet, and PROFIBUS International is responding with the concept of 'PROFInet
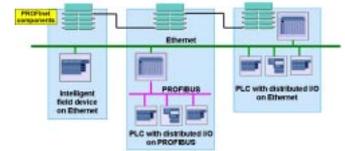
IO'. First products are due during 2004. The full applications functionality will be implemented step by step, which will take some time.

USE OF LATEST STANDARDS

⊳ OPC DX: a dynamic way of transferring data between different fieldbus platforms over Ethernet. Effectively, a horizontal software 'bridge' between systems.

⊳ TCP/IP: the accepted transmission protocol for Ethernet. Future PROFInet extensions will be fullly compatible.

⊳ DCOM: with TCP/IP the basic transmission methodology of PROFInet.

⊳ XML: for 'describing' how information is constructed, making it easy to transmit between different systems.

⊳ DHCP: for dynamically allocating IP addresses. PROFInet can also handle fixed IP addresses.

⊳ SNMP: 'simple network management protocol' for remotely managing and configuring Ethernet devices.

⊳ HTML: along with HTTP, required for Web interaction. All aspects of PROFInet - including components - can be managed using a browser.
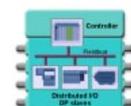
▸ PROFInet QUESTIONS ANSWERED

Newcomers to PROFInet always have many questions. We asked Edgar Kuester, Chairman of PROFIBUS International, to answer some of them.

Q: Can I use PROFInet now?
A: Of course, the PROFInet run time software has been available since July 2002 from www.profibus.com. The SRT functionality will be available in July 2003. IRT will follow end of 2004. Some aspects of PROFInet are still undergoing development, but nothing is preventing the use of the technology today. Indeed, starting now will give people a head start over their competitors.

Q: Does PROFInet obsolete PROFIBUS?
A: Definitely not in the next 5 to 10 years! PROFIBUS, as the No. 1 fieldbus worldwide, is well accepted and the best proven system with a very large range of application profiles. Today, PROFInet can only offer the basic communication functionalities of PROFIBUS, but our intention is to convert existing PROFIBUS application profiles to the world of PROFInet in coming years.

Q: So, what will happen to PROFIBUS when PROFInet products become available?
A: Smaller stand alone automation systems without need to be connected to the IT world will always be realized cheaper with PROFIBUS. Therefore I expect the PROFIBUS business to grow healthily for a long time.
If all PROFIBUS applications are eventually made available with PROFInet, the growth of new applications may gradually migrate but I also expect customers to integrate existing PROFIBUS applications into PROFInet solutions. The market may segment, but it will also grow in total for both.

Q: PROFInet uses an Object Oriented approach to engineering. Why is this necessary?
A: Object oriented structures enable you to create and easily integrate autonomous units of automation as well-proven software modules that can be re-used over and over again. Other benefits include a higher degree of software quality and failure-free software.

Q: PROFInet is clearly relevant to larger organizations like car manufacturers but won't it be too expensive for SMEs?
A: PROFInet fits both kind of customers. The most benefits are achieved if the application requires distributed automation structures and/or connectivity with the open IT world.

Q: Ethernet can't be real time or deterministic, so how will PROFInet help with Motion Control?
A: Ethernet by itself has no real time capability or deterministic behavior. But real time capability is directly dependent on the data transfer load.
If this is less than 50% and the real time demands of a specific application are not too high there are several alternatives. Modification of UDP is one of them. For PROFInet we have developed a lean and powerful software-based real time solution called SRT, which covers the usual requirements of factory automation and is comparable with the real time behavior of normal fieldbuses. The highest degree of real time capability is required for Motion Control. Typically this demands a maximum cycle time of 1 msec and a jitter of maximum 1 μsec. We are already developing such a solution for PROFInet. It's called Isochronous Real Time, or IRT. Both PROFInet real time solutions will coexist with TCP/IP without restriction.

Q: What is a PROFInet proxy?
A: Proxy is the term for our technical solution for integrating other fieldbus systems e.g. PROFIBUS or DeviceNet. The technical basis for all Proxies is the same because they are based on Microsoft COM/DCOM.

Q: I have Ethernet in my plant now. Will I have to change my network infrastructure?
A: PROFInet is based on Standard Ethernet and TCP/IP. If you have a switched LAN the network infrastructure can be used for PROFInet. You might need to ruggedize parts and for data security reasons you might wish to be careful regarding access rights but otherwise PROFInet runs on standard Ethernet structures.

Q: What is PROFInet I/O?
A: It will be the PROFInet way of linking de-centralized field devices directly to Ethernet. Products will not be available for some time. Also, the full range of PROFIBUS applications profiles can only be implemented step by step, so standard PROFIBUS I/O will stay current for many years. Most customers are looking for a solution to how existing PROFIBUS plants can be integrated into new PROFInet plants. With our Proxy technology we make it possible to fully protect existing investments.

Q: PROFInet depends on DCOM and ActiveX. Aren't both no longer supported by Microsoft?
A: DCOM and ActiveX are Standards used worldwide and they will continue to be used for many years, even if Microsoft does no further development. Both solutions are proven in millions of applications and fit perfectly with PROFInet. If other solutions just as proven and accepted arrive we are able to exchange DCOM and ActiveX. Also, DCOM is not necessary,

as alternative communications channels can be used.

**Q: Will PROFInet become an International Standard?**
A: PROFIBUS and PROFInet are already part of the approved IEC Standard 61158/61784. As a Liaison Partner of IEC SC65, PNO will bring the PROFInet Installation Guide into the standardization process as the basis for a new industrial cabling standard.

Q: Does this standard also include a solution for real time capability?
A: At the end of May IEC started a new standardization project for Ethernet based real time solutions which strictly conform to the international standards ISO/IEC 8802-3 and IEC 61784. PROFInet with its SRT and IRT extensions fulfil the requirements. Therefore we are confident that both extensions will become part of the planned standard.

Q: Is PROFInet proprietary?
A: Definitely not! PROFInet is an open Standard according to IEC 61158 and is coexistent with IEEE 802-3. We have taken care to incorporate open, standardized technologies such as DCOM, XML, OPC, SNMP and so on. Anyone can get and use the available PROFInet software and any existing fieldbus can be integrated using several options. Proven PROFIBUS philosophies underpin the entire PROFInet project but they are defined by open, international standards. Of course, we have to ensure that PROFInet is used in the correct ways, so Certification processes will be strictly observed, but otherwise nothing is 'hidden'.
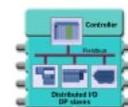
⇢ DEVELOPERS' CORNER

THREE WHITE PAPERS ON PORTING

Platform independence is an important aspect of PROFInet. Three White Papers devoted to porting PROFInet are available:

⇢ Implementing the PROFInet run time software based on an embedded real time multi-tasking kernel

⇢ PROFInet – Porting example for Linux

⇢ PROFInet – Run time Stack Porting on VxWorks

Copies are downloadable from www.profibus.com

HELP SOURCES

Hilscher North America tells us they can offer comprehensive assistance covering: PROFInet Stacks for Windows CE, I/O test boards, a PROFInet Proxy, PC/104 interface modules, a single-chip solution for linking to a PROFInet network, Engineering Tools and an OPC Server. **Hilscher: +1 630 836 8677 or pmarshall@hilscher.com**

Softing, actively involved in PROFInet work groups, now wants to offer its know-how to potential users and OEMs. A technology workshop and advanced developer seminars are planned. Softing will also provide consulting and customized portation services. Softing's own range of fieldbus and control products will be fitted with PROFInet interfaces, with first products available in early 2004. **Softing: +49 89 45656 379 or www.softing.com**

COMPETENCE CENTERS CAN PROVIDE SUPPORT

PROFInet Competence Centers (PNCCs) have been set up for supporting integration of PROFInet into devices, or other OSs, or for embedded systems. Services offered range from hotline support to the execution of individual, problem-oriented workshops. PNCCs also offer support in the implementation of PROFInet components and proxies. PNCCs have become a permanent part of the efforts of PROFIBUS International to guarantee the high quality of PROFInet products. Current PROFInet Competence Centers are:

ComDeC, Germany : ComDeC@fthw.siemens.de

ifak, Germany : info@ifak.fhg.de

PIC, USA: Ronald.mitchell@sea.siemens.com
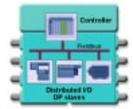
PNCCs in foundation are:

BFH, EdiSoN, Switzerland : max.felser@hta-be.bfh.ch

Hilscher, Germany : profinetcc@hilscher.com

SUPSI, EdiSoN, Switzerland : robertin@die.supsi.ch

TMG i-tec, Germany : info@tmgitec.de

ZHW, EDiSoN, Switzerland : thomas.mueller@zhwin.ch

MORE HELP FROM ...

TMG i-tec can offer PROFInet services ranging from technology integration in different hardware and software architectures, porting PROFInet software to RTOS, analysis of architectures, interface definition and specification, and device certification support. **TMG i-tec: info@tmgitec.de**

⇢ PROFInet PRODUCTS

PROFInet CPU

One of a group of new Simatic S7 CPUs, the CPU 317-2 PN/DP, has one PROFIBUS interface and one Ethernet/PROFInet interface. In addition to the combination PROFIBUS DP/MPI interface, the new Ethernet CPU 317-2 PN/DP provides a 100 megabit/s Industrial Ethernet interface based on the PROFInet communication standard. Like the SIMATIC NET IE/PB Link and the SIMATIC WinAC PN, it is used as proxy-capable network interface between Ethernet and PROFIBUS for component based automation. PROFInet enables data interchange between intelligent devices from different manufacturers. The SIMATIC iMap tool allows communication links to be established graphically simply by drawing lines, a wonderfully user-friendly alternative to programming. **Siemens: www.siemens.de/cba.**

REAL TIME PROFInet ON THE WAY

PROFIBUS International (PI) is developing two real time extensions for PROFInet, one for general automation applications and the second for high performance motion control.

SRT, or Soft Real Time, achieves cycle times of 5 to 10 msec and satisfies the demands of factory automation and is fully compatible with the TCP/IP Ethernet protocol. The run time software will be available to PI members end of July 2003 from www.profibus.com.

PI has also begun development of an Isochronous Real Time solution (IRT), for motion control applications. 150 axes will be controlled with a cycle time of 1 msec and a jitter of less than 1 μs. This will make PROFInet more powerful than any currently available real time solution yet still fully compatible with the TCP/IP standard.

IRT will rely on next generation switching technology and a four-port real time ASIC switch is being developed for implementing IRT in products quickly and easily so additional switches will be rendered unnecessary. In addition, the ASIC switch offers the possibility to build up interrupt-free redundant solutions for complex applications at very low extra costs. The objective includes porting the PROFIBUS motion control profile largely unchanged to PROFInet as an important contribution to protecting existing PROFIBUS investments.

PROFInet working groups are expected to complete the IRT specification in 2004. **PROFIBUS International: +49 (0)721 - 9658 - 590 or info@profibus.com or www.PROFIBUS.com**
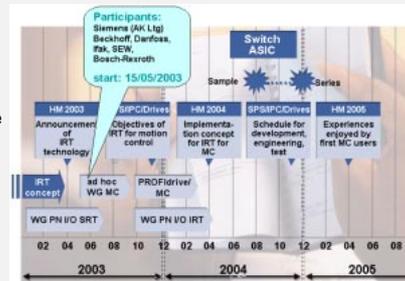
⏵ PROFInet APPLICATIONS

MODULAR BASE COAT LINE SAVES ENGINEERING TIME, PROVIDES FLEXIBILITY

The Paint Systems Division of the Dürr technology group supplies entire paintshops for automobile manufacturers. Their latest *Eco*DIM system, now in use at VW in Wolfsburg, Germany, is based on PROFInet.

The first system, a basecoat area based on over 60 networked modules, was commissioned in March 2002. Distributed automation based on PROFInet has made it possible to implement the modularization consistently and to reduce system complexity.

The basecoat area consists of pretreatment, cathodic dip coating (CDC) and a dryer for gradual drying of the base-coated bodies. The individual system sections are implemented as autonomously operating technological units. A continuous-flow dryer consists, for instance, of the following modules: 6 Convection re-circulating-air units, a fresh-air unit, a thermal exhaust-air cleaning unit, an exhaust air unit, a cooling zone and two rolling shutter doors. Each module contains a distributed Simatic ET 200S peripheral unit with its own CPU, networked via PROFIBUS.

Each Simatic ET 200S was firstly programmed with Step 7. The input and output

CDC dryer
Structure of a continuous-flow dryer

Drying of the painted body in several steps
- Throughput time of a body 30-45 minutes
- Temperature in the dryer 140-185 degrees
- Distance between bodies in the dryer approx. 10 cm
- Belt speed approx. 3 m/min
- Cycle time approx. 2 min
- System length approx. 150 m
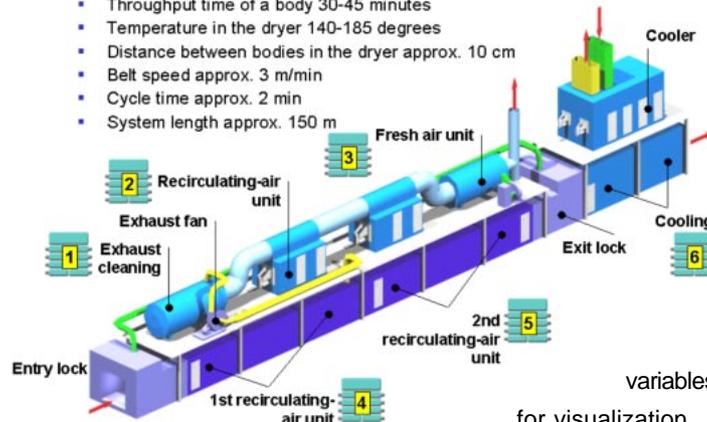
variables of the component interface were then defined from a technological point of view in a data block, e.g. "Open roller shutter door", "Roller shutter door is open" and "Entry stop" etc. Finally, an XML file which describes the entire component was generated using the "Create PROFInet component" function. The components were then imported to the iMap engineering tool which provides a view of the entire system. The communication relationships between the technological interfaces of the components were then defined by dragging lines. This graphical linkage instead of programming greatly reduced the time taken for implementation and commissioning.

The Simatic Net PROFInet OPC Server on PCs is used for visualizing approximately 30,000 variables. The

variables for visualization were also planned using the iMap. The variable list is the OPC tag file in this case.

Ten to twenty Simatic ET 200S stations are connected via PROFIBUS in each of the individual system areas. The various system areas themselves are interconnected with a higher-level Ethernet network. Visualization and engineering

are also performed via this Ethernet network. Interworking of the PROFIBUS segments with the Ethernet network is performed via Ethernet/ PROFIBUS links with PROFInet proxy devices. The advantage of this is that existing intelligent PROFIBUS units can be used without adaptations.

For the Dürr company, PROFInet is a further step towards consistent modularization and decentralization. Reusability of the components is saving both time and money, thanks to the copying effect and the ability to continue using well-proven PROFIBUS products. Golf, Lupo and Touran bodies have been produced in the system and availability of the system, which now operates in three-shift mode, has been guaranteed at all times.

Basecoat paintshop A-MPV
Automation engineering
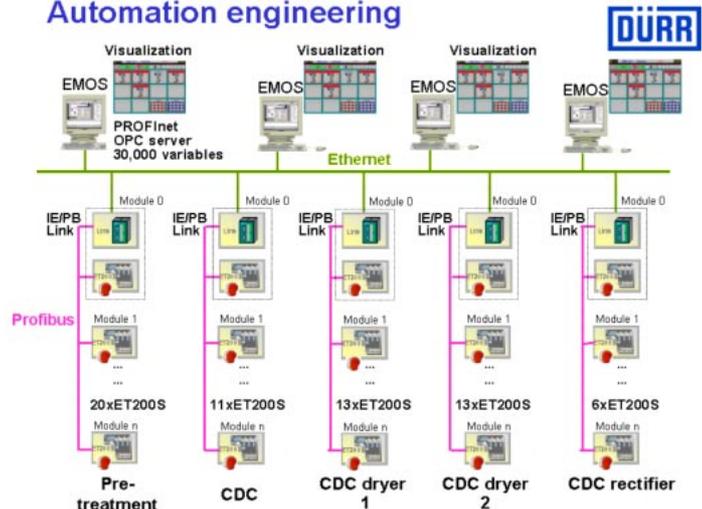
⏩ PROFINET TESTING AND ASSURANCE

QUALITY ASSURANCE IS ESSENTIAL

With the PROFInet project, PI has entered new territory as Quality Assurance of software presents a special challenge. PROFInet does not define a new protocol. Rather, it is based on the established TCP/IP and DCOM standards from the world of IT. PROFInet simply defines an object model.

The Run time Software source code is an integral part of the specification. The program source files in the programming language ANSI-C are openly available. Thus, any manufacturer who would like to develop and market PROFInet devices can do so. However, users of the

PROFInet Run time Software cannot make any kind of changes. If an error is found, then a change can only be done by the PROFInet development team after a release by the working group.

The PROFInet Run time Software includes a port instruction with examples of system adaptations. These can be downloaded by members from www.profibus.com.

Two features distinguish the PROFInet development from a 'normal' product

development: first, it is a team effort embracing several companies, and second, the outcome of the development is not a product but source code - which, as a special form of the specification, only becomes a product through porting and implementation. Both present new QA challenges which the PROFInet working groups continue to treat with great care. A further measure for quality assurance is the certification of PROFInet products.

STEPS IN PROFInet CERTIFICATION

A decisive step towards quality assurance is the certification of PROFInet devices. In close agreement with the PROFInet Core Team, certification guidelines have been drawn up. The first certification was completed at the end of 2002.

The most comprehensive part of certification - taking about 50% of the time - is the test of the run time software. This is made up of the run time kernel (made available by PI and already pre-tested) and the system adaptation by the device developer. The software parts modified by the user are first checked, then the implementation of the PROFInet object model.

Next comes the test for interoperability with an engineering tool. This takes about 20% of the total time and checks whether a produced PROFInet component can be integrated in an engineering tool. The third test looks at interoperability with other PROFInet components and takes about 30% of the total time.

An Interface test program is also undertaken to prove that PROFInet interfaces are correctly supported.

NEED TO KNOW MORE?

PI has published two useful full colour documents to explain what PROFInet is and what it can do. The first, entitled 'PROFInet: more than just Ethernet' is a promotional flyer (right) that provides an introduction to the first principles. An in-depth view is provided by the 28pp 'PROFInet Technology and Application: System Description', (right) which contains much detailed information about the technology. Both can be obtained free from www.profibus.com