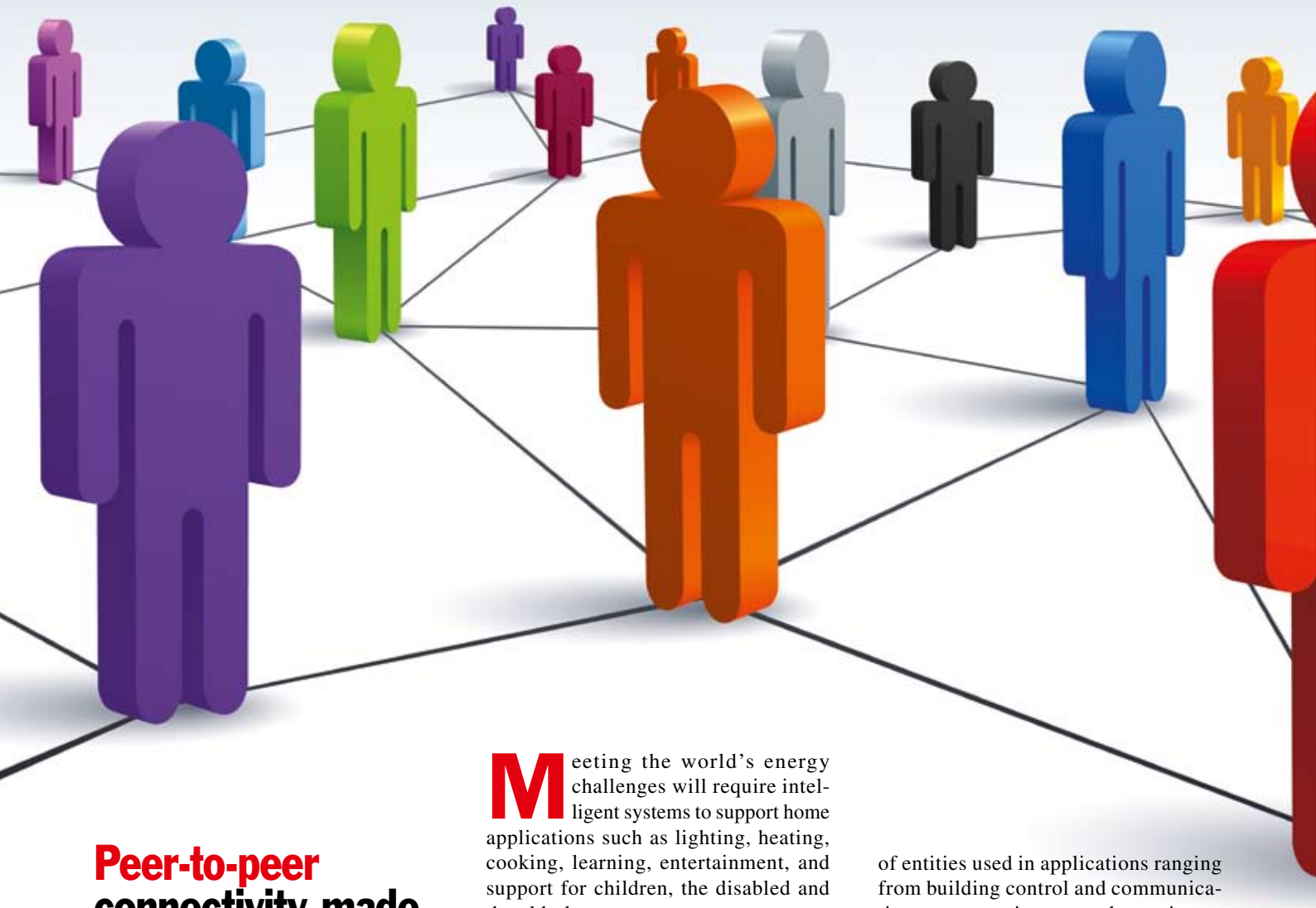
ISO and the Media



Peer-to-peer connectivity made easy

by Walter P. von Pattay, ISO/IEC JTC 1/SC 25, Interconnection of information technology equipment,
and Stefan Heusinger, Head of Standardization, DKE

Meeting the world's energy challenges will require intelligent systems to support home applications such as lighting, heating, cooking, learning, entertainment, and support for children, the disabled and the elderly.

If those systems are to succeed, products from multiple industries and competing companies need to work together. In the past, industry-specific standards committees within ISO and the International Electrotechnical Commission (IEC) developed International Standards that supported communication within certain industries.

Now, the multipart standard ISO/IEC 29341, *Information technology – UPnP Device Architecture*, published in 2008, bridges these industries. It supports intelligent homes by providing seamless communication for all kinds of entities used in applications ranging from building control and communications to entertainment and security, as well as offering specifications to control and service the home and its appliances from outside in a way that can be handled by the layman (see **Figure 1**).

Plug and play

Universal Plug and Play (UPnP) provides the layman with the means to establish multivendor and multitechnology networks. UPnP defines architecture for pervasive peer-to-peer network connectivity of networked appliances, audio and video equipment, sensors/actors and PCs of all shapes and

sizes whether they use wire or wireless transmission. It is designed to bring easy-to-use, flexible, standards-based connectivity to ad hoc or unmanaged networks whether in the home, small business or in public spaces.

The goals of UPnP are to allow devices to connect seamlessly and to ease multiple applications like entertainment, energy efficiency and building control through data sharing, communications, exploitation of the Internet and simplified network establishment. UPnP achieves this distributed, open networking architecture by defining and publishing UPnP device control protocols built upon established, open, Internet-based communication standards such as TCP/IP, UDP, HTTP, XML and SOAP (see "Quick glossary" **box**).

UPnP lies below layer 6 of the Open Systems Interconnection (OSI) reference model, and is used for automatic device management in a TCP/IP network, which is the type of network where devices and services capable of UPnP can be found. **Figure 2** *(overleaf)* shows the context of UPnP.

Zero-configuration networking

UPnP architecture supports zero-configuration networking. A UPnP-compatible device from any vendor can dynamically join a network, obtain an IP address, announce its name, convey its capabilities upon request, and learn about the presence and capabilities of other devices (see **Box** *overleaf*).

Dynamic Host Configuration Protocol (DHCP) and Domain Name Service (DNS) servers are optional and are only used if they are available on the network. Devices can leave the network automatically without leaving any unwanted state information behind.

The entire UPnP framework is described in the ISO/IEC 29341 series. Part 1 deals with the fundamental principles of UPnP and forms its base architecture. About 70 parts and subparts define specific applications and devices. For example, audio and video (AV) components are described in Part 3-1 (UPnP AV architecture:1), Part 3-10 (transport:1 service), Part 4-4 (data structure template:1), and Part 4-10 (transport:2 service).

Quick glossary

DHCP – Dynamic host configuration protocol

DNS – Domain name service

HTTP – Hypertext transfer protocol

OSI – Open systems interconnection

SOAP – Simple object access protocol

TCP/IP – Transmission control protocol/Internet protocol

UDP – User datagram protocol

UPnP – Universal plug and play

XML – Extensible markup language

UPnP connects internal and external entities

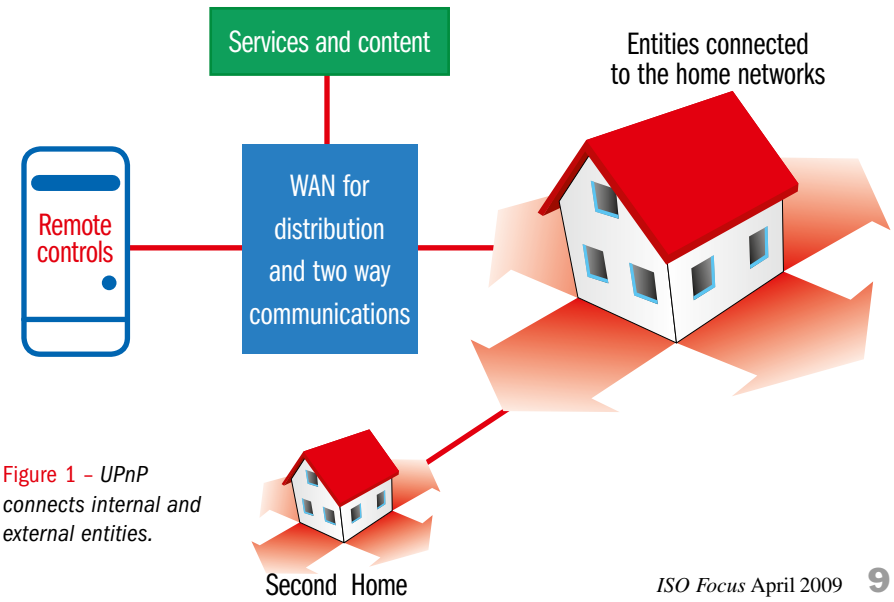


Figure 1 – *UPnP connects internal and external entities.*

When devices join a network

The following steps must be performed upon joining a network:

- **Addressing:** When first connected to the network, each device must have a DHCP client and search for a DHCP server. If no DHCP server is available (unmanaged network) the device must assign itself an address. If the device obtains a domain name during the DHCP transaction, it should use that name in subsequent network operations; otherwise, it should use its IP address.
- **Discovery:** After obtaining the IP address, the device communicates its capabilities and services to control points on the network through the UPnP discovery protocol. Similarly, when a control point is added to the network, the UPnP discovery protocol allows that control point to search for devices of interest on the network. The fundamental exchange in both cases is a discovery message containing a few essential specifics about the device or one of its services, for example, its type, identifier, and a pointer to more detailed information.
- **Description:** After a control point has discovered a new device, information about it is very limited. However, more comprehensive information can be retrieved through the pointer provided by the device in the discovery message. The UPnP description for a device is expressed in XML and includes vendor-specific information such as model name and number, serial number, manufacturer's name, and URLs to vendor-specific Web sites. The description also includes a list of embedded devices or services, as well as URLs for control, "eventing", and presentation. For each service, the description includes a list of the commands to which the service responds, and parameters for each action.
- **Control:** Having retrieved the device's description, the control point sends a suitable message to the control URL for the service. Control messages are also expressed in XML. Much like function calls, the service returns any action-specific values in response to the control message.
- **Event notification ("eventing"):** A UPnP description for a service includes a list of actions that the service responds to and a list of variables that model the state of the service when it is run. The service publishes updates when these variables change, and a control point may subscribe to receive this information. The service publishes updates by sending event messages, which contain the names of one or more state variables, and their current values. To support scenarios with multiple control points, eventing is designed to keep all control points equally informed about the effects of any action.
- **Presentation:** If a device has a URL for presentation, the control point can display the relevant page in order to allow a user to control the device and/or view its status, according to the specific capabilities available.

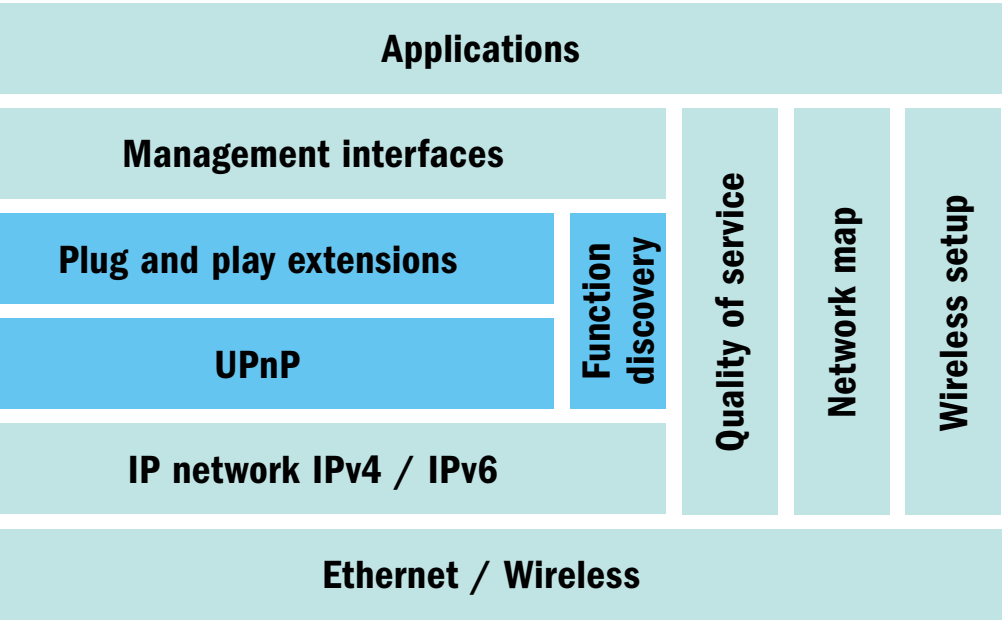


Figure 2 – *UPnP within the network.*

Yesterday, today and tomorrow

Together with other International Standards – such as the multipart standards ISO/IEC 14543-3-x and ISO/IEC 14543-4-x on home electronic systems architecture communication layers – ISO/IEC 29341 provides specifications to support a wide variety of applications that yesterday belonged to the realm of fantasy. Today, in the real world, they include:

- Archive photos, music and films on the PC or media centre and then watch or listen to them on the home theatre, TV, audio system, PC or mobile phone, anywhere in the world
- See a visitor ringing at your door on your TV set, PC or mobile phone, whether you are at home or away

- Operate your home appliances, heating and lights using the TV set and its remote control, the PC or mobile phone from within or outside your home
- Let the music follow you as you move about your house
- Create the illusion that your home is occupied by having lights go on and off and shutters move up and down
- Get an alert when your elderly mother falls at her house or does not move during a defined period of time
- Switch off heating and air conditioning as soon as a window is opened, and switch them on remotely before returning home
- Watch your pet on the PC or mobile phone while you are away, and fill the food dish by remote control.

Who says tomorrow never comes!

About the authors

Dr.-Ing. Walter P. von Pattay has served on ISO/IEC JTC 1/SC 25 since 1983, joining the committee while he worked with Siemens. In 1993, he obtained a Ph.D. based on his research into dissemination and market acceptance of networked systems and international standardization. In 2002, he was granted the DIN prize "Benefits of Standardization". Having retired from Siemens, he is continuing his engagement in standardization using the findings of his thesis.

Stefan Heusinger has long-serving professional experience in the fields of control engineering and numerically controlled machine tools, as well as in software development. In 2006, he became Technical Manager Standards within the DKE – the German Commission for Electrical, Electronic & Information Technologies of DIN and VDE. Since 2008 he is Head of the Department of Standardization.