Home sweet home
When integration becomes a reality

by Dr. Kenneth Wacks, Convener of ISO/IEC JTC 1/SC 25/WG 1, Home Electronic System

Manufacturers of appliances and consumer electronics are constantly seeking new products that can command higher margins in a very competitive market. These manufacturers are investigating product opportunities in home systems that enable new consumer features by interconnecting appliances, sensors, and control panels.

The home systems industry has been developing since the mid-1980s. Until then hobbyists had been jury-rigging remote controls for various home applications such as lighting and entertainment. This industry is now emerging as a major market segment for appliances and consumer electronics makers. The business objective of home systems is to offer consumers new products and services to enjoy at home.

The hallmark of this industry segment is the transition from stand-alone appliances to systems made possible by a home network. The home network enables the communications of commands, control, data, audio, and video among devices via wires or wirelessly.

About a billion dollars has been invested in creating networking technologies and components for home systems.

Sleeping soundly at night

Our homes are replete with devices that improve the operation of the house and make life more convenient, productive, and safer. These devices range from large appliances in the kitchen and utility room, to entertainment products and an endless array of small appliances throughout the house. In addition, we have sensors and control devices for lighting, heating and cooling, and security. Each device or group of devices is independent of the others.

Consider your routine before retiring at night:

- Adjust the thermostat for comfort and conservation,
- Make sure the range, oven, and coffee maker are off,
- Turn off most lights,
- Shut the TV, radio, and stereo,
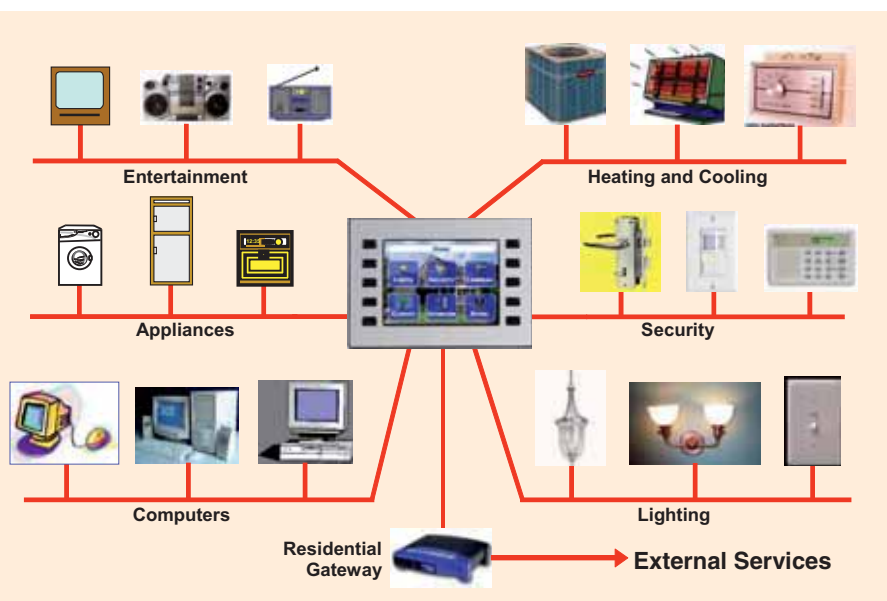- Secure the door locks,
- Set the alarm clock for wake up.

Figure 1 – *A network of home appliances*

It certainly would be convenient to have a single 'good night' switch that initiated the same routine. A few high-end home systems on the market offer similar features. The manufacturers accomplish this integration usually with a proprietary network and proprietary interfaces to the device under control. A mass market will develop only when appliances and components can be interconnected and can interoperate with low-cost technology.

"The standards should help manufacturers to ensure connectivity and interoperability among appliances and control devices."

In the future, as we buy products for our house, we will connect them to our home network, as illustrated in **Figure 1**. Here we see an example of a home network organized into sections, each supporting a cluster of related appliances:

- Entertainment: TV and radios,
- Environmental comfort: heating and cooling,
- Lighting,
- Kitchen appliances,
- Computers,
- Home security and access control.

All these clusters of appliances may be operated from a control panel shown in the middle of **Figure 1**. The control panel connects to the Internet via a Residential Gateway. The Residential Gateway brings in cable television, DSL (data services via telephone lines), satellite video and audio, and enables Internet access.

With a home network installed and then connected to the Internet, we will be able to buy services from companies that might provide us with music, video, and games. Appliance companies might check that our kitchen appliances are working properly and will be able to find problems early before the appliance breaks.

At the click of a button

A home network provides an electronic pathway among appliances, sensors, controllers, and user interfaces. **Figure 2** shows how kitchen appliances connect to a home network. Each appliance is fitted with an electronic module called a "network interface" that connects it to the home network. This slide shows the network interface that is actually a small electronic circuit inside the refrigerator.

Home appliances are operated with a variety of buttons, knobs, and keys on each appliance. Furthermore, control methods and panel layouts are usually different for each appliance. With a home system, for example, we might control our house from special switches on the wall; one switch might turn on all the lights, while another switch turns on music. We might manage the house from control panels installed on the wall near the entrance to each room, or we might use a portable computer or mobile telephone to control appliances – no matter where we are or what we're doing at the time. It's no longer a utopian idea that just before leaving work to go home, for example, a quick call to the house might start getting dinner ready and/or make the indoor temperature comfortable for our arrival home.

Making networks work together

While dozens of home network communications schemes have been developed, many of these networks will not work together. This poses challenges for manufacturers who want to sell the same products in each country and benefit from economies of scale. It is better to use the same network design and to develop different appliance designs. That is why ISO and IEC created working group WG 1, *Home Electronic System (HES),* of ISO/IEC JTC 1/SC 25, *Interconnection of information technology equipment.*

The WG 1, *Home Electronic System* comprises a set of standards that span a variety of topics related to home systems:

HES architecture

One of the first projects of the HES working group was the creation of a generic home network architecture. This specification was completed and published more than five years ago as a series of technical reports (ISO/IEC TR 14543, *Home Electronic System architecture*.) The architecture document is being expanded to include
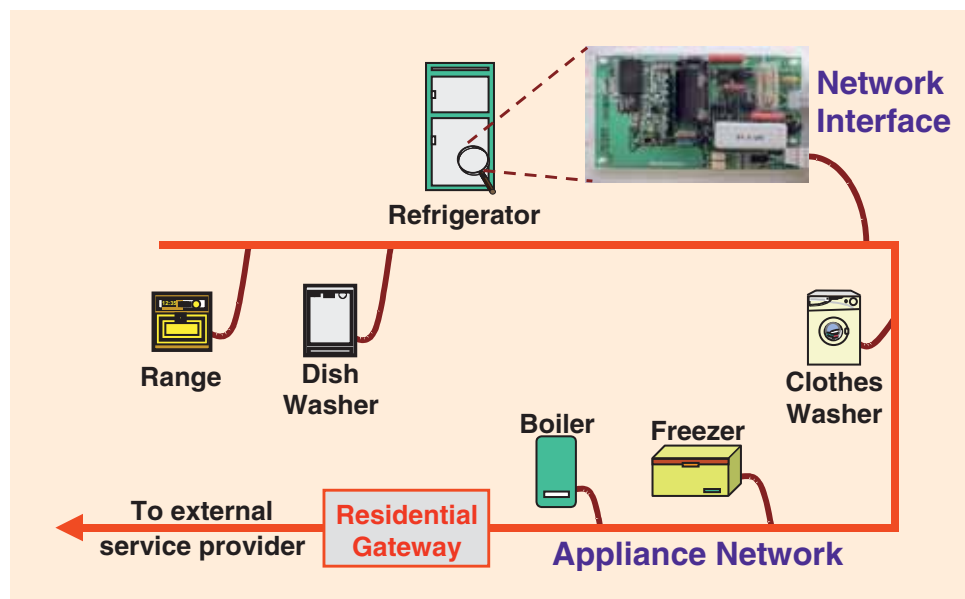

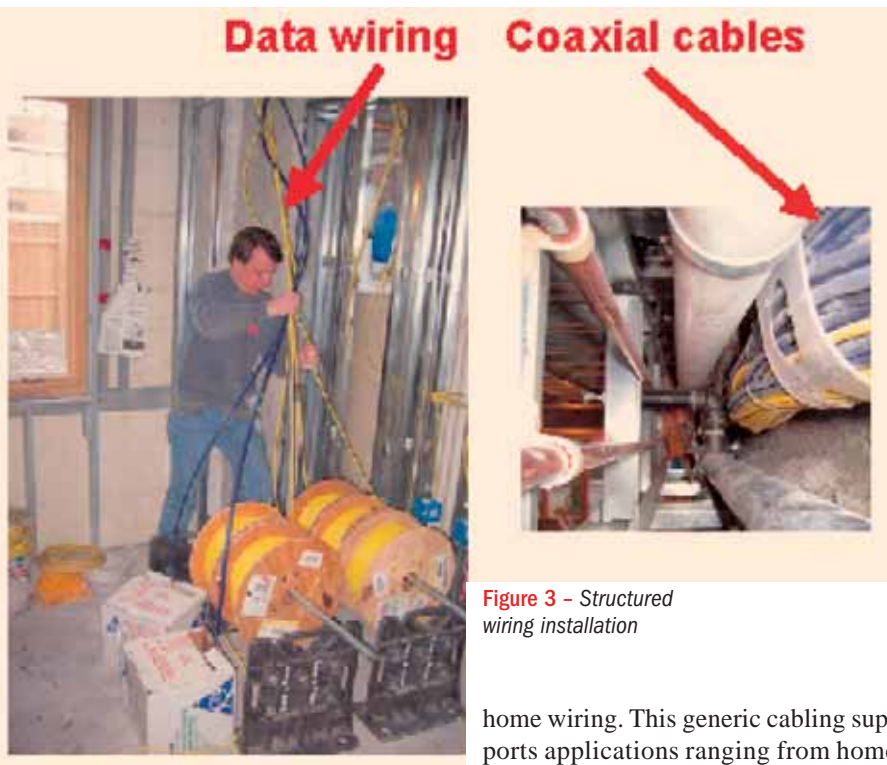Figure 2 – *Connecting appliances to a home network*

Data wiring **Coaxial cables**

Figure 3 – *Structured wiring installation*

communications protocol standards from various regions in Asia, Europe, and North America.

Networked appliance safety

ISO/IEC TR 14762, *Guidelines for functional safety,* was published at the request of the IEC Advisory Committee on Safety (ACOS). Issues of safety become challenging when appliances may be controlled from outside the house via a pathway that may include a remote computer, a telephone, the Internet, a residential gateway, a home network, and an appliance interface. A failure at any point could impair appliance safety and endanger users.

Integrated cabling for home networks

More than half of new homes in some countries are being wired with home networks, initially to support broadband Internet access from multiple locations in the house. Home systems applications can share this wiring. A joint project team composed of WG 1 and WG 3, *Customer premises cabling,* were formed to develop ISO/IEC 15018, *Generic cabling system for homes*, and to establish standards for home wiring. This generic cabling supports applications ranging from home control to data to audio and video.

Figure 3 contains photographs from a recent installation of structured wiring in a new apartment building. The yellow wires carry computer and appliance data. The blue wires are coaxial cables for TV distribution.

The residential gateway

The growth and pervasiveness of the Internet have created opportunities for new home services enabled by connecting a home network to outside service providers via the Internet. This network connection is made possible by the residential gateway. The multipart standard under the general title, ISO/IEC 15045, *Information technology – Home Electronic System (HES) gateway*, is being prepared for the residential gateway, informally known as the HomeGate.

The primary responsibility of the gateway, as shown in **Figure 4**, is to translate digital messages and data between the communications format outside the house and the format used by the home network. In addition to the translation feature of a communications gateway, HomeGate includes requirements for privacy, security, and safety via the incorporation of firewall features in hardware and software. A firewall limits what types of messages can flow into and out of the house to ensure privacy. Firewall provisions in the gateway enforce agreements between service providers and residents as to access rights and access times. As an example, if an occupant allows monthly meter readings, the firewall could preclude the utility from daily readings. Also, the gateway optionally may be configured to block commands that could place an appliance in an unsafe mode. For example, turning on a cook top from a remote location might be prohibited.

The HomeGate physical device may be one box or multiple boxes, possibly interconnected. A general-purpose gateway may include plug-in cards, illustrated in **Figure 5**. This would permit adaptations for various Wide Area Networks. Options include signaling via cable TV, satellite, digital telephone techniques (DSL), broadband over power line, and wireless. On the house side, cards are shown for a choice of home networks. To promote interoperability, HomeGate will also accommodate optional interconnections among various local area network protocols.

About the author

Kenneth Wacks has been the Convener of ISO/IEC JTC 1/ SC 25/WG 1 since 1997. He is a pioneer in establishing the home systems industry and is a management advisor to clients worldwide (**www.kenwacks.com**). He advises manufacturers and utilities on business opportunities, network alternatives, and product development in home and building systems. Dr. Wacks received his PhD in communications from the Massachusetts Institute of Technology (MIT) as a Hertz Fellow and studied at the MIT Sloan School of Management.
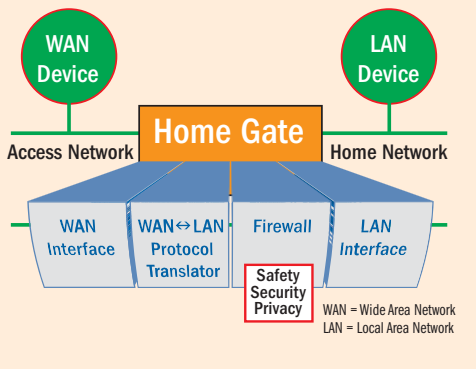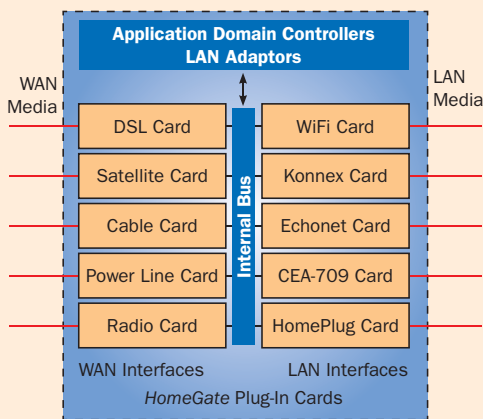
Figure 4 – *Residential gateway*

Figure 5 – *Residential gateway example.*

Figure 6 – *Application of Backbone Network standard.*

Product interoperability

Rules for interoperability are essential because we are creating an integrated set of functions from devices that may be produced by multiple manufacturers. The first and most important decision is what is the application and how will the various components and appliances cooperate to serve the user.

> **"The business objective of home systems is to offer consumers new products and services to enjoy at home."**

A multi-part standard, ISO/IEC 18012, *Guidelines for product interoperability,* is being developed with the goal of providing seamless applications among products designed for a variety of incompatible networks carrying incompatible commands and control signals. This standard overcomes these obstacles with models for common applications and representation of commands in an XML-based syntax that is independent of any particular communications protocol. Most of the application models to be incorporated into this standard have already been published as technical reports (ISO/IEC TR 15067).

Backbone and Component Networks

The Backbone and Component Network Interfaces, ISO/IEC 20587, currently under development, is to interconnect a variety of disparate home networks, called Component Networks, via interfaces to a common network, known as a Backbone Network. The Backbone Network supports all classes of applications from command and control up to streaming data for audio/video (A/V) using wires and non-wired media to carry the application signals from the Component Networks. **Figure 6** illustrates a possible application of this standard, including links to external service providers.

Home Electronic System security

The proposed Home Electronic System (HES) security standard, ISO/IEC 24767, addresses security between an external network from a service provider and a home network, and security within a home network. This standard defines the Secure Communication Middleware Protocol (SCMP) to support internal security services of home networks.

The ultimate goal – the integrated home

For home systems to function, the network and the connected appliances must all work together. Integration is the promise of a home network, but the reality is that each appliance operates separately and differently from each other appliance. The standards of SC 25/WG 1 should help manufacturers to ensure connectivity and interoperability among appliances and control devices to enable new home services. The ultimate goal of an integrated home system is the electronic equivalent of a staff of servants at our b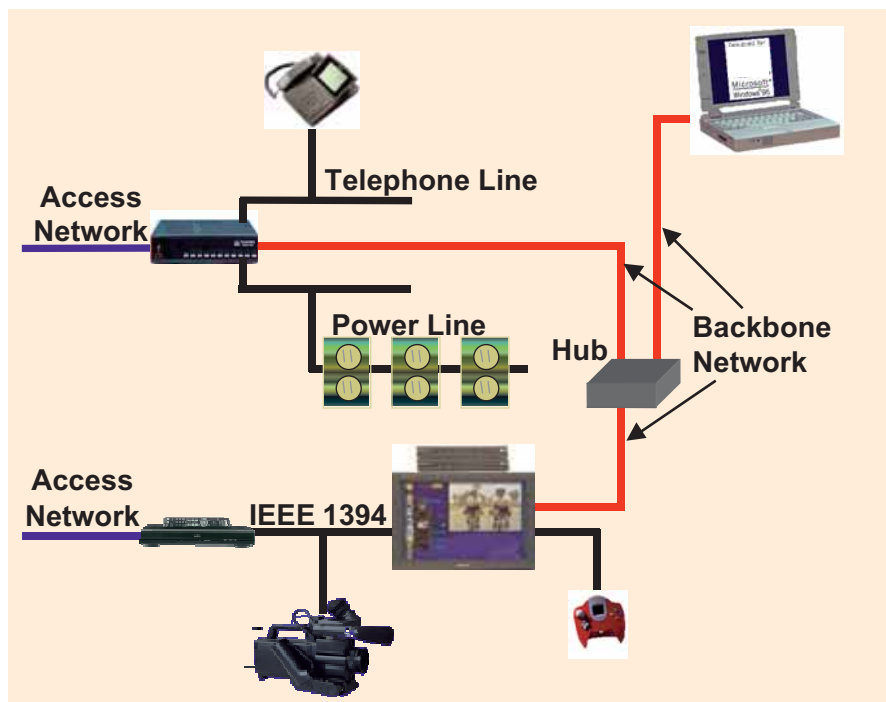eck and call, all the time, at a price we can afford. ∎