INFORMATION TECHNOLOGY (IT) IN THE HOME

THE EVERYDAY LIFE OF A HOUSEHOLD IN CYBERSPACE

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My thanks to Dr. Eicher and ISO for the opportunity to speak to you today on the topic of Information Technology in the Home and how IT can help to improve the quality of life in the 21st century.

This is an exciting topic to think and talk about because, as Information and Communications Technologies continue to advance, the possibilities seem limitless for how the home of the future can assist its occupants and improve their quality of life. As Chairman of ISO/IEC JTC 1, I am also pleased to be able to present information on how JTC 1 is working to provide standards to enable the home of the future.

In this presentation, we will look at "What's happening in the home and cyberspace" today. We'll look at some industry trends, such as the growth in the number of computers and the rapid expansion of the Internet, and then define some concepts relating to the home in cyberspace, such as "smart houses" and "information appliances".

After establishing some of the reasons that the home will get "smarter", we will look at some scenarios describing "who benefits and how will they benefit". The smart home will have powerful connections to the outside world and an internal network of devices that assist the occupants in their daily lives.

When is this going to happen, that is, "when and how will the home get to cyberspace"? From your own personal experience, you probably know that this is already beginning. But we will look at some of the technologies that will enable the home of the future and how numerous industry and standards efforts are defining the interfaces, protocols and architectures needed to support the smart home and its connections to the outside world.

Finally, I'll draw some conclusions and summarize.

What's happening in the home and cyberspace? What trends are occurring in Information and Communications Technologies that are causing the home to move to cyberspace and what are some of the current concepts that will help us better understand the situation?

Continuing developments in Information and Communications Technologies are profoundly altering the way people live, work, play, communicate and learn. Some trends enabling advances for IT in the home are:
- Computers have dramatically decreased in size since their invention and will continue to get smaller and more powerful.
- In the past twenty five years, computers that were once housed only in restricted, environmentally protected areas, have moved out into the open on desktops, in homes, on

people and embedded in other devices. As this trend continues, computers will be everywhere helping people manage their daily lives. Telephones that were once solidly affixed to walls and connected by wires are now in people's pockets and wireless. The dramatic increase in the use of cellular phones is an indicator of people's desire for technology that is convenient and can help increase their productivity. Computers will be embedded in offices, classrooms, homes, vehicles, equipment and clothing. These computers will be networked together and to the Internet through both wireless and wired communications. Computers will be able to sense the environment and react "intelligently". People will use computers without even realizing it.

- User interfaces to computers have evolved from complicated command languages known only by a few to windowed, menu driven, click and point interfaces. But even "friendlier" user interfaces are on the way. With advances in speech recognition, language translation and text-to-speech synthesis, the once forbidding access to computers will be as easy as speaking in one's native language.

- The last trend is the explosive growth of the Internet and continuing improvements in wireless and broadband technologies. The Internet is cyberspace and millions of people browse and surf it for commercial, educational, social and entertainment purposes. This trend will continue as more and more users and information sources are linked to the Internet. Broadband communications will enable the quick exchange of data, and wireless communications will make it easy to have computing and communication devices anywhere.

Let's look at some **basic concepts and terminology** related to the home in cyberspace.

A **"smart house"** is one whose subsystems, such as security, lighting, entertainment, heating, cooling and communications, work together enhancing each other's capabilities. A smart house uses computers to help its occupants live healthy, happy and safe lives by performing many tasks automatically to help manage the household.

Pervasive computing refers to the proliferation of computing devices (other than desk-top computers) that are embedded in buildings, homes, walls, doors, vehicles, roads, etc. It also includes computing devices that are worn by people or embedded in clothing, and small portable computing devices, such as personal digital assistants and smart cards. In pervasive computing, the computing devices are typically miniaturized, and connected to the global Internet.

A **home network** is the collection of connected devices and appliances in the home for transporting and sharing information. The connection can be to disparate subsystems managing a variety of devices or appliances including personal computers, audio/video equipment, set top boxes, refrigerators, climate control systems, doors, lights, etc.

An **information appliance** is a specialized computing device designed to perform a single task (unlike a general-purpose computer) and, conversely, a more traditional appliance performing its primary task that has also been upgraded to exchange information with other devices and systems. In addition to digital assistants, refrigerators, coffee makers and mirrors become information appliances as capabilities are added to them to process and exchange information.

Bandwidth refers to the amount of data that can be transferred in a specified period of time, e.g., seconds. Bandwidth is an important concept to consider in the cyberspace environment due to the large amounts of data that need to be transferred quickly to provide timely responses to users.

A final concept that I'd like to mention is **accommodation**. This refers to the development of technological solutions that accommodate individuals with special access needs (e.g., those with disabilities such as motor impairment, blindness or deafness). Accommodation is intended to assure that evolving IT solutions will not disadvantage such individuals. Interestingly, solutions developed for people with special access needs also solve many of the problems faced by others such as the elderly, and in fact become applicable as convenience factors for products in general. What is proposed as a solution for a specific group can become the general solution. The concept of accommodation applies to IT in the home as well as IT in the workplace and public spaces.

So, **who benefits from IT in the home and how** will they benefit? To get an idea, we'll look at some scenarios describing life in the home in cyberspace. We will look at scenarios describing the home from different perspectives: inside the home, outside the home, the occupants, and in the automobile.

In the **bedroom**, the morning alarm wakes you up with a synthesized voice reminding you of the time that you requested to rise and mentioning items that you wanted to recall first thing in the morning. The alarm is synchronized with your electronic schedule available on other information appliances in your home and office and might ring later than usual if it logs on to find out that there's a delayed opening for the kids at school due to inclement weather. In the nursery, the nanny camera keeps watch. Alarm clocks in the other bedrooms sound based on the family members' recorded schedules.

Proceeding to the **bathroom**, the mirror over the sink provides the morning news headlines, the medicine cabinet identifies family members through biometric recognition permitting authorized access to daily medicines. The bathroom scale recognizes who has stepped on, records weight and percentage of body fat and sends the measurements off to the appropriate health care group to record progress on a personal and private chart available via the Internet. The toilet monitors the family members' general health by chemical sampling and forwards the information to the family health care group.

In the **kitchen**, the Internet refrigerator pad displays the family schedule, latest news, traffic and weather, and transmits the grocery list to the Web grocery store. The list has been compiled by scanning chips in the grocery items, noting their absence from the refrigerator and maintaining the shopping list. The coffee maker checks the family schedule, starts brewing at the appropriate time and give a friendly "birthday" greeting to a family member who's birthday it is. When you're away from home, the coffee maker checks the schedule and doesn't brew the coffee. The microwave and oven read the chips in the food items inserted, check the recipes, turn on and cook according to instructions. The dishwasher detects a new kind of detergent and remotely upgrades the software to adjust cycles accordingly. Like other information appliances connected to the Internet, the manufacturer will automatically be contacted if there's a malfunction so that the appliance can be repaired remotely or service personnel dispatched.

In the adjacent **laundry room**, the washer and dryer monitor the chips in the clothing to determine the proper settings to continue the cycles. Like other smart appliances, the washer and dryer can discover each other, exchange information and discover the family information center appliance. The dryer displays a message at the information center that the clothes are now dry. The appliances can also monitor energy usage and send recommendations for appropriate actions to regain energy efficient operation. Many of the information devices will

be "instant-on" and ready to transmit and receive without the start-up delay of today's typical PC. User interfaces will include speech activation, as in "turn on the porch lights".
In the family room, the communication center, the interactive TV is used to shop online, send and receive e-mail messages, make phone calls over the Internet, telecommute, pay bills and hold video conferences with business associates, family and friends. The doctor's office has just sent an appointment reminder directly to the communication center. One can relax with an electronic book, with selected contents readily available via the Internet and home computer. Videos, audio and movies can be downloaded on demand and electronic games are played across the Internet.

Throughout the house, sensors are integrated into the home electronic system to provide management and control of subsystems for security, lighting, climate control, energy utilization, entertainment and communications. Lights are turned on automatically based on a schedule or via alarms, windows opened, air conditioning and heating regulated and security monitored. Informational and alerting messages are displayed at the family information center.

Outside the home, a sensor embedded in the driveway notifies the communication center when a vehicle approaches. You're at the office and notified from your home system with a video clip from the front porch digital camera revealing that a truck delivering goods has arrived. As you were expecting the delivery, you direct the home PC to deactivate the alarm system, open the door, turn on the lights and switch to the digital camera in the living room to observe the delivery, saving a special trip home from the office.

If it is dark when you arrive home, motion sensors or a remote control on a key chain can be used to turn on lights in any room in the house. If an intruder attempts to break in to the house, a digital surveillance camera takes a picture that is saved on the computer inside while the security system notifies the police. The picture can also be transmitted with the call. The exterior environmental monitoring system determines that the sprinkling system doesn't need to be turned on due to the current rainy weather.

As the occupants of the home in cyberspace move into the 21st century, **the Internet becomes wearable**. Computers will be embedded in items people wear such as wristwatches, eyeglasses, belts and head mounted devices. Intelligent assistants can be close by on one's person that combine speech recognition, problem solving and animated personalities to quickly provide answers to questions.

Wearable computers will also be used for sensing medical information, such as cholesterol, blood sugar and blood pressure levels. Such devices will provide continuous monitoring and have secure access paths through which to report findings to the appropriate medical group. For this application and many others related to IT in the home, security, authentication and authorization will be important needs to be satisfied.

Computers and sensors will be embedded in clothing, not only for care and laundering purposes but for information storage and retrieval purposes, e.g., maintaining schedules.

Personal assistants such as schedulers, smart cards and mobile phones, will incorporate increasing intelligence and functionality. PAs will permit ready access to personal information, communication with home and office, the ability to handle finances and many other tasks that will increase the effective use of people's time. For young children, PAs will serve as electronic ID tags with personal identification information and position-based locator capabilities. For the elderly, PAs will have similar monitoring capabilities, quick access to medical information and help functions in case of emergency. Students will routinely have

very thin, light and powerful notebook-like computers responding to voice instructions and transcribing written notes into digital format, as digital scribes.

An important feature of all of these types of personal and wearable computing devices is the capability to be networked with home and other information centers.

When considering the home occupants, we cannot forget the family pets. Tags that contain identification information as well as locator capabilities can help keep track of the pets' whereabouts. Such electronic tags can also be used in connection with kitchen devices for feeding pets at scheduled times and entry mechanisms attached to pet doors for unassisted exit and re-entry.

On board navigational systems for **automobiles** are just beginning to appear in the marketplace. These navigational systems will not only know where the occupants are but will obtain directions for where they're going via the Internet.

Cars will also have Internet connections for obtaining information and services while on the road. These include weather, traffic and road conditions and will provide assistance in re-routing to get the occupants to their destination with the least delay.

Cars may be outfitted to communicate with the home and send instructions back and forth, for example, to turn on the lights at home or receive a reminder to run an errand. Car security systems will be linked to the home security system.

Automobiles today already have computers monitoring their operation. In the future, when the car senses an equipment failure, it will communicate to the home or other information base via the Internet to find the nearest repair location.

Based on these scenarios, it's easy to see that there are many ways in which the household occupants will be assisted by Information Technology in the home. Easy to use interfaces throughout the home will be close by to provide access to all kinds of information for educational and entertainment purposes. Information gathered in the home can be quickly exchanged with health care providers to monitor one's health and receive instructions on diet, nutrition and medical needs. Monitoring devices in and around the house will be able to quickly alert the household members of potential dangers. The monitors will also be able to contact local police, fire and medical assistance in case of emergencies.

Communication devices will be everywhere throughout the house and on household members and will not just serve for internal communications. Through the Internet and high-speed communication lines into the home, communications to the outside will be ubiquitous and fast. The combination of networked information appliances and communication devices all working together will free the household occupants from many time consuming tasks thereby permitting more family "quality" time.

An additional thought regarding the home of the future: in the scenarios just described, there are obviously a large number of options for getting information and having tasks handled automatically. Not all IT solutions may be appropriate or desirable for everyone. As households do today, they will make choices from the available information, communication and control devices for what best meets their needs.

The scenarios we've looked at showed examples of what life will be like in the home of the future. The next question is: **when is this going to happen?** The obvious answer is that it is already starting to happen. The Internet is here today and reaching into million of homes.

Home automation systems are available now although they are not typically networked with all types of information appliances or with the Internet. "Smart" versions of traditional appliances are still generally in the prototyping stage.

Within the next several years, we will continue to see a proliferation of information devices from personal digital assistants to electronic books and digital scribes to wearable computers. Traditional appliances will have information and communication features added. There will be dramatic increases in bandwidth to move high volumes of data and at lower cost. High quality display devices will become less expensive and more prevalent, speech and natural language processor technology will become more readily available. Most of these advances will occur within the next ten years, making the scenarios just described commonplace.

Let's now look at some of the **technologies** that will enable the type of information exchange, appliance control and high-speed communications that will characterize the home of the future. We'll also look at **how standards will help bring the technologies together**.

With the advent of multiple PCs and peripheral devices in the home came the need for home networking. Now with the growth of the Internet, the proliferation of computing devices and the potential for numerous additional networked information appliances, the home networking market is receiving considerable industry attention. Home networking has a different set of needs and constraints than corporate networking, such as: smaller number of users, monetary constraints, differing infrastructures and types of usage. Vendors are currently developing technologies that target only a few users, can be affordable for in-home applications, take advantage of existing wiring infrastructures in homes and address shared Internet access from multiple devices. Some of the technologies being utilized are home phone lines, local area networks, wireless transmission and power lines. Some of the pros and cons for utilizing these technologies for home networking applications are as follows.

Home phone lines offer an existing infrastructure that is known to the consumer, can be utilized at relatively low cost for networking and applications, and scales to higher line speeds. There may be some limitations in the number of phone line jacks available in an existing home that would require upgrading the infrastructure.

Local area networks, such as Ethernet, are common in the corporate environment and are now being offered in home networking kits. Ethernet is a proven technology, offers high data transfer rates and is relatively inexpensive. To take advantage of scaling to higher data speeds, additional cabling would need to be added that would increase the cost to the homeowner. Wired home networking solutions can be easily addressed in new construction, but do pose some considerations on how best to upgrade for existing homes.

A number of industry efforts are underway to develop wireless radio frequency LAN specifications and to address considerations needed to obtain higher bandwidth, e.g., maintaining strong signals to ensure reliable communications. **Wireless networks** offer significant benefits of mobility, flexibility and convenience but do not yet offer the price/performance of phone line technology.

Power line networking utilizes a home's existing electrical system for data transport and has been used for some time in command and control systems within the home. These systems are now being developed into PC-oriented systems. Power line solutions for in-home networking don't require new wires to be installed and are relatively inexpensive, comparable to phone line solutions, but scalability for higher bandwidth still needs to be achieved.

It is likely that home-networking solutions may actually use combinations of two or three of these technologies in the future.

While lower bandwidths can be used to automatically control devices and appliances in the home, the transfer of video streams and large amounts of data from and to the Internet is increasing the need for broadband access to the home. Technologies such as cable modems, packet cable and digital subscriber line services are being introduced to satisfy these needs. As broadband becomes more widely deployed with increasing numbers of networked devices, home networks will migrate to the residential gateway concept.

A **residential gateway** is a device that connects other devices in home area networks to the wide area networks beyond the home. With the different kind of connections into the home and different options for controlling devices within the home, the home information and communications centers that control home networks can utilize different types of devices such as set-top boxes, televisions, personal computers, telephones and residential gateways.

By the very nature of the complexity of the interface and interoperable systems needed to support IT in the home, **standards** provide a number of benefits to the consumer. Standards enable a number of specialized solutions from multiple vendors to inter-operate so that the consumer is guaranteed a choice of suppliers and not locked into only one solution. With the infrastructure defined by standards, the market will be offered a number of competing solutions that can all work together and at competitive prices that will lower costs. The consumer will still be able to pick and choose standard components with assurance that they will work compatibly with other selected standard components.

A number of standards bodies, industry forums and consortia are tackling various aspects of the overall solution.   Some of these are:
- ISO, IEC and ITU -- a number of technical committees and study groups are working on standards for the component IT and communications technologies. (ISO/IEC JTC 1 is one of those technical committees and I'll describe some of JTC 1's work with the following slides.)
- The Internet Engineering Task Force (IETF) is developing protocols for the Internet as the basic transport mechanism between the home and cyberspace.

There are also numerous industry forums and consortia working on solutions to support IT in the home. This is by no means an all-inclusive list, but some of these groups and their areas of work are listed on this and the following slide. The number of these groups indicates the complexity of the situation. Without going into each one in detail, I'll describe the general areas of their standards work:
- The Bluetooth consortium and the Home Radio Frequency Working Group are developing specifications for wireless in-home communications between a variety of devices.
- BatiBUS , Consumer Electronic Bus (CEBus), European Installation Bus (EIB), European Home System (EHS), Home Bus System (Japan), Home Plug and Play, Lonworks, Universal Plug and Play and X-10 are all working in the home automation arena to provide integrated systems to control environment, security, access, safety and other in-home subsystems.
- The Home Audio Video Interoperability (HAVI) organization and HomeAPI Working Group are working on software specifications for control of in-home devices, and the Home Phoneline Network Alliance (HomePNA) is working on phone line networking standards for the home.

To give you an idea of JTC 1's involvement in standardization that will support IT applications in the home, I will briefly mention some of the JTC 1 Subcommittees and their work in this area:

- SC 2 *Coded Character Sets* standardizes the representation of multi-lingual character sets used for language representation, interchange and translation.
- SC 6 *Telecommunications and Information Exchange between Systems* develops international standards for local area networks in cooperation with the IEEE. SC 6 is also working with some of the previously mentioned consortia to bring their work into the formal international standards process.
- SC 17 *Identification Cards and Related Devices* develops standards for ID card technologies and applications that can apply to the home as well as other environments.
- SC 25 *Interconnection of IT Equipment* has done extensive work in the field of Home Electronic Systems, building cabling and wiring.
- SC 27 *IT Security Techniques* provides generic standards for security systems, including cryptography and authentication mechanisms that can be used in a variety of security systems, including those for the home.
- SC 29 *Coding of Audio, Video, Multimedia and Hypermedia Information* provides compression standards, such as MPEG, that enable the timely transfer of video images as data.
- SC 31 *Automatic ID and Data Capture Techniques* standardizes bar coding and radio frequency technologies that will support some of the scenarios described previously for the home in cyberspace.
- SC 34 *Document Processing and Description Languages* standardizes ways to represent documents, including all types of content for interchange among systems and devices.
- SC 35 *User Interfaces* standardizes input devices such as keypads and gesture-based systems to improve ways in which users interface with systems.

These are just some of the ways in which ISO/IEC JTC 1 standards will help support the evolution of the home of the future. More information is available via the Internet at the JTC 1 website (www.jtc1.org).

One of the standards that JTC 1 SC 25 has been developing is *Home Electronic Systems* (HES) (ISO/IEC 14543). A primary goal of HES is to specify hardware and software interfaces so that a manufacturer might offer one version of a product that could operate on a variety of home automation networks. HES specifies a worldwide architecture that includes the following components:

- a universal interface module to be incorporated into an appliance;
- a command language for appliance-to-appliance communications independent of which network carries the messages; and
- the HomeGate residential gateway to link home control networks with external service provider networks.

SC 25 is also developing application models for home lighting control, energy management and security. The March 1999 issue of the *ISO Bulletin* contained an article on SC 25's work entitled *"Home sweet home - standards for a home that thinks for itself".*

What conclusions can we draw from examining the directions for IT in the home?

First, technological advances are enabling the evolution of the smart home. The advancements in home automation coupled with the rise of home networking systems and access to the Internet make it possible for the home to become much "smarter" and to greatly assist its occupants in their daily lives.

Second, savings in personal time and increased personal productivity as a result of the home automatically handling many time-consuming tasks, coupled with the increasing access to information, monitoring of health and safety needs and other benefits, will help to improve the quality of life in the 21st century.

And third, while there is still a way to go to have all the technology in place, it is rapidly advancing and the benefits will become more and more visible in the near future. With all of the disparate technologies involved in providing the home of the future, standards will enable the interfaces and interoperability needed for the home in cyberspace and will play a key role in bringing the technologies together in ways that will benefit us all.

Information Technology (IT) in the Home

The Everyday Life of a Household in Cyberspace

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Overview of IT in the Home

- **What's happening in the home and cyberspace?**
  (Trends and Concepts)

- **Who benefits and how will they benefit?**
  (Scenarios)

- **When and how will the home get to cyberspace?**
  (Technologies and Standards)

- **Conclusions and Summary**

What's happening in the home and cyberspace?

Trends affecting IT in the Home

- **Decreasing size of computers**

- **Increasing number of computing and communication devices**

- **Friendlier interfaces**

- **Growth of the Internet, Wireless and Broadband communications**

Some Concepts

- **Smart House**

- **Pervasive Computing**

- **Home Network**

- **Information Appliance**
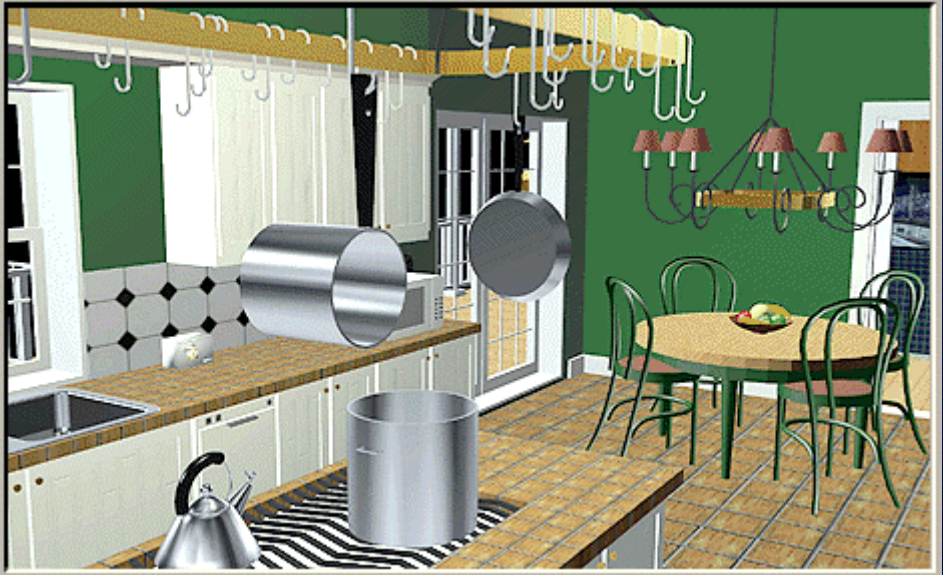
- **Bandwidth**

- **Accommodation**

Who benefits and how will they benefit?

Scenarios

Inside the Home

Outside the Home

The Occupants

- **Wearable computers**

- **Computers embedded in clothing**

- **Personal Assistants**

- **Student notebooks, digital scribes**

- **Pet monitors, feeders, entry**

The Automobile

- **Navigational systems and directions**

- **Internet connection for information/services**

- **Monitoring road conditions**

- **Communicating with home**

- **Sensing equipment failure and finding nearest repair location**

Benefits

- **Information and education**

- **Health and Safety**

- **Emergency Assistance**

- **Ubiquitous communication**

- **Family "quality" time**

When and how will the home get to Cyberspace?

Technologies

- **Home Networking**
- **Broadband Communications**
- **Residential Gateways**

Standards Bodies and Industry Forums

- **ISO, IEC, ITU**
- **IETF**
- **Industry Forums and Consortia, including:**
  - BatiBUS
  - Bluetooth
  - Consumer Electronic Bus (CEBus)
  - European Installation Bus (EIB)
  - European Home System (EHS)
  - Home Audio Visual Interoperability (HAVI)

Standards Bodies and Industry Forums

- **Industry Forums and Consortia, (continued) :**
  - Home Bus System (HBS)
  - HomeAPI
  - Home Plug and Play
  - Home Phoneline Network Alliance (HomePNA)
  - Home Radio Frequency WG (HomeRF)
  - LonMark Interoperability Association (Lonworks)
  - Universal Plug and Play
  - X-10

ISO/IEC JTC 1 and IT in the Home

- **Some ISO/IEC JTC 1 SCs working in this area:**
  - SC 2, Coded Character Sets
  - SC 6, Telecom. and Info. Exchange between Systems
  - SC 17, Identification Cards and Related Devices
  - SC 25, Interconnection of IT Equipment
  - SC 27, IT Security Techniques
  - SC 29, Audio, Picture, Multimedia Coding
  - SC 31, Automatic ID and Data Capture Techniques
  - SC 34, Document Descr. and Processing Languages
  - SC 35, User Interfaces

(Visit http://www.jtc1.org for more information)

ISO/IEC
Home Electronic Systems

- **JTC 1/SC 25 Home Electronic Systems (ISO/IEC 14543)**
- **Worldwide architecture specifying:**
  - **Universal Interface**
  - **Command Language**
  - **HomeGate residential gateway**
  - **Application models for lighting control, energy management and security**

Conclusions and Summary

- **Technological advances are enabling the evolution of the smart home**
- **Resulting benefits will improve quality of life in 21st century**
- **Standards will play a key role in bringing the technologies together**