ITU G.hn concept and Home Automation

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For long time, many in the buildings industry have been looking for a day when home automation systems would become fully integrated with communication and human-interface practices, with standards widely employed for information technology. Now the time is coming in the form of the ITU Recommendations G.hn.

1 SmartHouse concept

The most important approach in the field in home automation is the European "SmartHouse Code of Practice" [1]. Figure 1 shows the key role of the residential gateway (home gateway) in a SmartHouse framework.

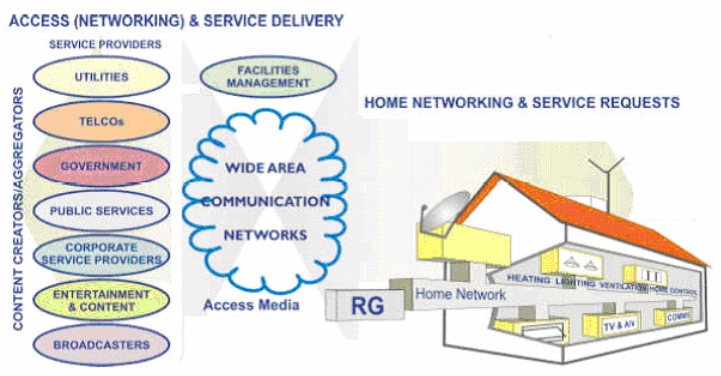

Fig. 1. Role of the RG in a SmartHouse framework.

The SmartHouse consists of a large and wide ranging set of services, applications, equipment, networks and systems that act together in delivering the "intelligent" home in order to address security and control, communications, leisure and comfort, environment integration and accessibility. Table below illustrates the relationship between the technical requirements on bandwidth and SmartHouse services offered.

Table. Examples of SmartHouse services and associated bandwidth.

Services offered	Band Width Narrow → Broad
Automatic Reader metering	
Energy management (energy saving	
Home Control	
Security(Intrusion – detection)	
Presence simulation	
Technical alarms	
Windows/door opening	
Safety (sensing)	
Maintenance	
Remote Diagnosis	
Medical Monitoring (Basic)	
Community Care and Sensitivity	
Digital TV & Video	
Video Conferencing	
Voice over IP	
On-line Gambling	
Health – Medical care	
Health and well being	
On-line Music	
On-line and download gaming	
Home shopping	
Learning and education	
Family and local networks	
Home security +CCTV	
Video on demand	
Video on request	
Home working	

The G.hn approach should enable the ability to manage home electronic systems from one main control point and make our household run smoother, feel better and save energy [2], taking into account many home automation requirements, particularly:

Interoperability. A good example of interoperability is having the lights turn off, the thermostats set back when you press a "goodbye" button on a keypad or when a motion sensor notices that you have exited a room.

Remote Access. Remote access capabilities allow us to monitor our home's environment and alter the settings of the lights, thermostats and other gear if necessary all from your laptop or cellphone.

Expandability. It is important that a home automation system can be easily expanded both vertically to incorporate additional products and horizontally to support additional rooms. Manufacturers can support vertical and horizontal expandability by designing their systems to speak a common network language, like IP (Internet Protocol), and by offering wireless products that can communicate with a home's existing network of wired products.

Upgradeability. Software is the driving force of an automation system. The more sophisticated that software is, the more the system can do (see HGI picture below).

Variety of Interfaces. In the age of universal graphical user interfaces (GUI), is there any reason to continue using a different home automation manufacturer's graphics instead of Web-browser-type operator interfaces?

Energy-Savings. One of the hottest topics in the consumer media is energy conservation. Automation systems can help save energy by turning off electronics devices automatically.

2 ITU Recommendations G.hn

The ITU concept G.hn is a worldwide standard, addresses technology for wired home-networks. G.hn is the common name for the "next generation" home network technology standard. The G.hn technology goal is to unify connectivity of digital content and media devices by providing a network over three popular types of wiring found in homes today: coax cable, phone lines, and AC power wiring and to supply data rates up to 1 Gbit/s. The ITU G.hn standard's goal is to specify the physical (layer 1) and link (layer 2) layers for home wired networks (Fig. 2). This work culminated in Recommendation ITU G.9960 specifying G.hn's Physical Layer.

The G.hn Data Link Layer is divided into three sub-layers: 1) Application Protocol Convergence (APC) Layer, which receives Ethernet frames from the application layer and encapsulates them into G.hn MAC Service Data Units, 2) Logical Link Control (LLC), which is responsible for encryption, aggregation, segmentation and automatic repeat-request, and 3) Medium Access Control (MAC), which schedules channel access in according to TDMA method to avoid collisions.

G.hn specifies a Physical Layer based on fast Fourier transform (FFT) Orthogonal frequency-division multiplexing (OFDM) modulation and Low-Density Parity-Check FEC code. OFDM systems split the transmitted signal into multiple orthogonal carriers. These carriers are modulated using Quadrature amplitude modulation (QAM).

The G.hn Physical Layer is divided into three sub-layers: 1) Physical Coding Sub-layer (PCS), for generating PHY headers (Fig. 3), 2) Physical Medium Attachment (PMA), for scrambling and FEC coding/decoding, 3) Physical Medium Dependent (PMD), for bit-loading/stuffing and OFDM modulation. The PMD sub-layer is the only sub-layer in the G.hn stack that is "medium dependent" (ie, some parameters may have different values for each media - power lines, phone lines and coaxial cable). The rest of sub-layers (APC, LLC, MAC, PCS and PMA) are "medium independent".

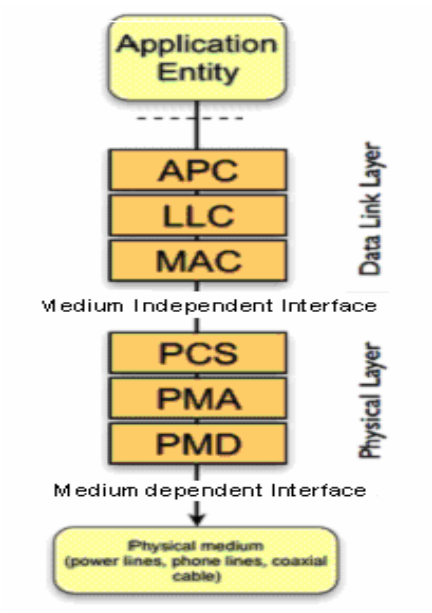

Fig. 2. G.hn node protocol stack.

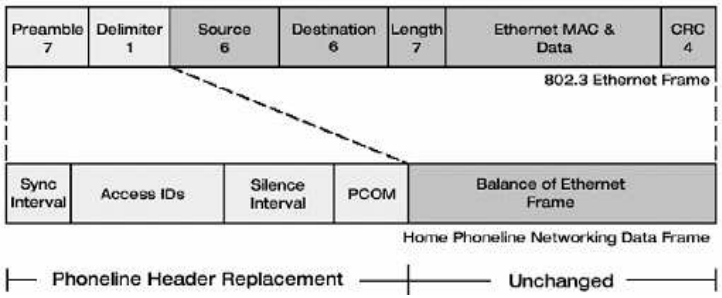

Fig. 3. Home phoneline networking data frame is based on Ethernet standards.

G.hn proponents are working now to make G.hn the future universal wired home networking standard worldwide. G.hn profiles for home automation are on further study yet (Fig. 4).

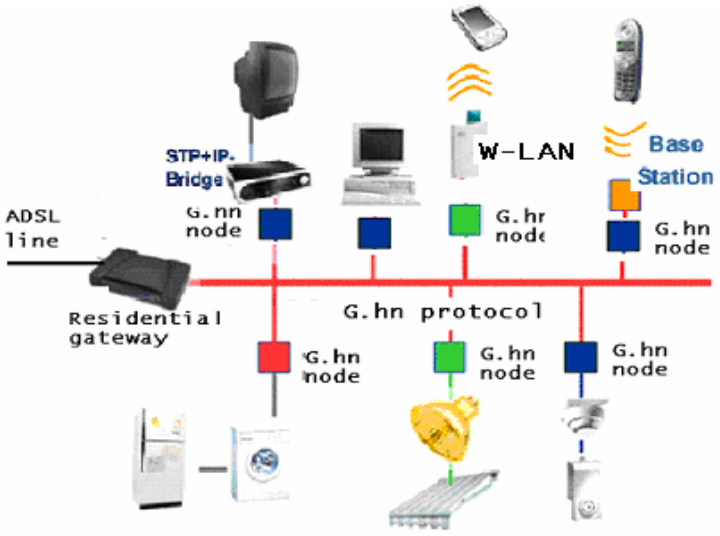

Fig. 4. Example of a G.hn network.

3 Home Gateway Initiative: RG software development approach 1

There are currently several competing service delivery architectures now. OSGi Alliance is one of erlier, and Home Gateway Initiative is the newiest.

The Home Gateway Initiative (HGI) is an open forum launched by a number of telephone companies (Belgacom, BT, DT, FT, KPN, Teliasonera, NTT, Telefonica, Telecom Italia) in December 2004 with the aim to release specifications of the home gateway. Many manufacturers (including Microsoft) have joined the alliance. The initiative will drive the development of residential gateways supporting the delivery of services.

The initiative will take as a basis the work undertaken within existing bodies (such as ITU-T, Broadband forum, DLNA, OSGi Alliance, etc). The goals of the initiative are to produce and downstream requirements for a residential gateway enabling end to end delivery of services (Fig. 5), to work with manufacturers in order to leverage volumes, to validate with manufacturer against uses cases and requirements, to ensure interoperability.

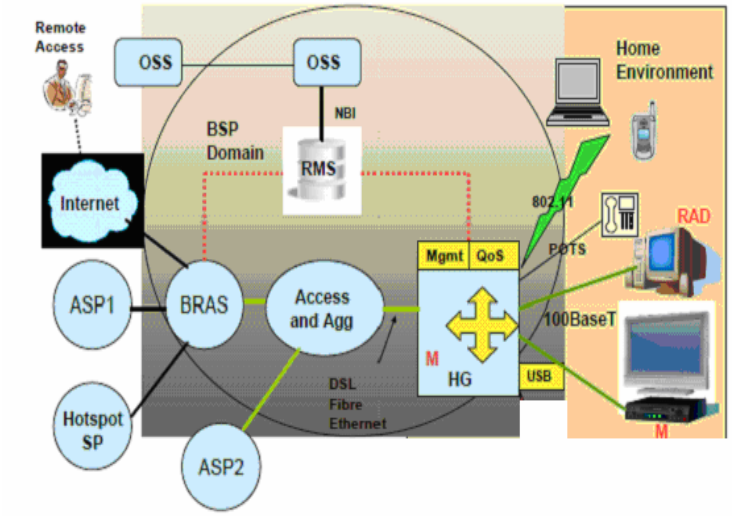

Fig. 5. Home gateway environment according to the HGI concept.

4 OSGi Alliance: RG software development approach 2

The OSGi Alliance(formerlyas the Open Services Gateway initiative) was founded by Ericsson, IBM, Motorola, Sun Microsystems and others join in 1999. Among its members are more than 35 companies from quite different business areas. The Alliance and its members have specified a Java-based service platform that can be remotely managed (Fig. 6). (We are with Java-based service platform for long timr, see http://abava.blogspot.com/.)

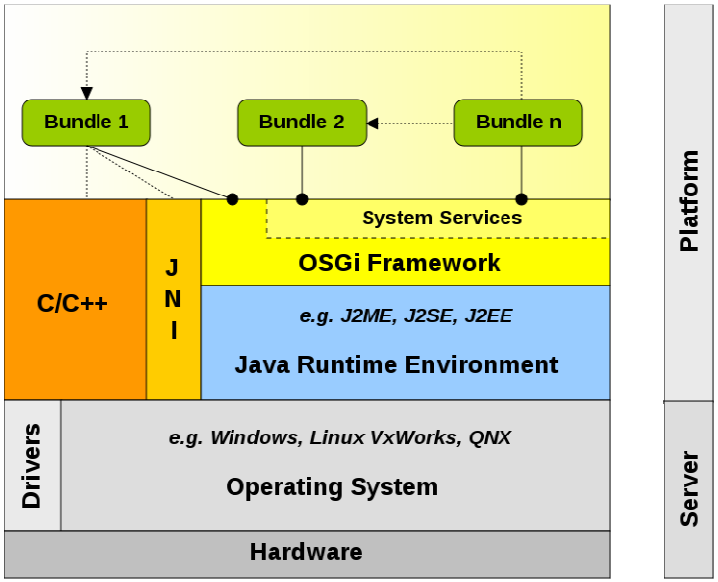

Fig. 6. OSGi Service Gateway Architecture.

5 Conclusion

The right time is now to develop the G.hn profiles for home automation. According to Wikipedia [4], three home networking organizations that promoted previously incompatible technologies (CEPCA, HomePNA and the Universal Powerline Association), announced that they had agreed to promote G.hn as the single next-generation standard for wired home networking, and to work to ensure coexistence with existing products in the market. The Continental Automated Buildings Association (CABA) and HomeGrid Forum signed a liaison agreement to support HomeGrid Forum's efforts in conjunction with ITU-T G.hn to make it easy for consumers worldwide to connect devices and enjoy innovative applications using existing home wiring.

Case studies. The paper is illustrated by case studies (from Latvia):

Case 1. The KNX (Konnex) standard based demonstration room is arranged by Urban Art company (Riga) in cooperation with University of Latvia. Time switch programs enable users to heat or ventilate each room individually, while a remote control is also available for operating light switches, monitoring windows and doors for home security. The web server enables users to operate intelligent room from any PC or smart phone, requiring only a common operating system and a browser. Another new feature is the alarm function that sends e-mail or text message warnings to four predefined recipients.

Case 2. Abavanet company (Ventspils) has developed a series of m-bus controlled devices for water supply automatic measurement (wireline and wireless).

Case 3. MikroDators company (Ogre) has produced wireless measuring devices for hot water supplier Rigas Siltums company.

References

1. SmartHouse Code of Practice, CENELEC, CWA 50487, Nov 2005
2. http://www.electronichouse.com/article/10_features_to_look_for_in_a_home_automation_system/
3. Home Gateway Technical Requirements, 2008, http://www.homegateway.org/
4. http://en.wikipedia.org/wiki/G.hn