Computer Standards & Interfaces 31 (2009) 1175–1181

Contents lists available at ScienceDirect

Computer Standards & Interfaces

journal homepage: www.elsevier.com/locate/csi

Mapping standards for home networking

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ARTICLE INFO

Article history:
Received 5 June 2007
Received in revised form 11 April 2009
Accepted 15 April 2009
Available online 21 April 2009

Keywords:
Compatibility standards
Home networking
Technological convergence

ABSTRACT

In this study, we apply a step-by-step approach for the identification of standards for home networking. We develop a classification and we use this classification to categorize sixty-four (sets of) standards. By developing this categorization, we have brought order to the chaos of home networking standards.

1. Introduction

The situation where different types of technology in a home environment can communicate with each other and form one home network is becoming a viable one. Irrespective of the fact that the home network has been technically possible for many years and that there seems to be a demand for it [1], it has not yet become a practical reality. The lack of a dominant standard for the interconnection between subsystems of the home network is one of the primary reasons why the home network has not yet emerged [1–3]. One of the explanations behind the fact that not one dominant standard has, as of yet, emerged is the mere amount of standards that exist in the market for home networking. We intend to reach order by applying a step-by-step approach to the identification of standards and we try to classify the standards.

We start by studying the system in which the standards are used with the aim of developing our categorization. Next, we will give an overview of the different standard setting organizations that are involved. Subsequently, for each standard setting organization, we will provide the standards and we will classify them according to the categorization developed.

In 2002, Den Hartog et al. [4] performed a similar study. Our study builds on, and extends, the study of Den Hartog et al. [4] in several ways. First, we will take into account standards that were developed from 2002 to 2007. Second, by applying a step-by-step approach, we intend to reach a more complete list of standards. Third, we will develop a classification which can be used in future study to better compare the different standards to each other.

2. Analysis of the home network

2.1. Architecture of the system

The home network should be seen in a larger context in order to fully understand it. In Fig. 1, an architectural overview of an end-to-end communication network is presented. The core network enables the communication of information between service providers, whereas the access network enables the communication of information between the service provider and the consumer. Our interest lies in the private network, which enables the communication of information in the home. Attached to this network is the home platform in which several subsystems (such as consumer electronic devices) are located which can, by making use of the private network, communicate with each other. Through the home interface, which consists of the residential gateway, the subsystems used in the home platform can communicate with the outside world. In the access platform, access to the internet and billing services are located and the service platform is both a multimedia and an open services platform.

2.2. Type of standards related to the architecture of the system

In this study, we will primarily focus on compatibility standards since they are crucial for the connection of subsystems in a larger system [5]. We will define a compatibility standard as a codified specification defining the interrelations between entities [6] in order to enable them to function together [5]. In our search, we will take into account both proprietary and open standards, but also understand that the existence of proprietary standards will not always be

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doi:10.1016/j.csi.2009.04.002

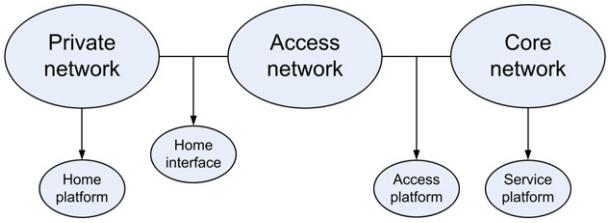

Fig. 1. Architectural overview of the home system [11].

communicated, decreasing the number of proprietary standards that we find.

Standards are defined at different layers in the architecture of a system [7]. Since home networking standards in practice provide partial or complete solutions for *application*, *communication* or *network* concepts, we will distinguish between application service standards, communication service standards and network service standards. Application service standards originate from the need to resolve the functional, communication and network requirements of one or more applications with independent distributed functions. These concepts specify a generic application model and application messaging process, the process for message communication and the solution(s) for networking that support the application, messaging and communication requirements. Often, these standards are referred to as "middleware." Communication service standards originate from the need to resolve the communication and network requirements in an application environment with unnamed distributed functions. These concepts specify a generic communication model and process to transport data between application processes and the solution(s) for networking that supports the communication requirements. Network service standards originate from the need to resolve the network requirements for the communication support for distributed functions, proposing a typical medium-dependent solution for the transport of certain volumes of data between several (independent) nodes [8].

We make a distinction between the subsystem and system levels, since we focus on systems that (at least partly) consist of established subsystems. The established subsystems, located in the home platform in Fig. 1, usually already apply standards which can *potentially* also be used for the connection between these subsystems. We call these *subsystem standards*. Examples include GSM and Coax. We will call the standards that are newly developed for the interconnection of the established subsystems *system standards*. These standards concern the private network. Examples include Konnex and Zigbee. A third category of standards are subsystem standards that were originally used for the interconnection in one subsystem but are now also used to connect these subsystems to other subsystems. We will call these standards *evolved subsystem standards*. Examples include USB and Wifi. In Fig. 2, this is graphically illustrated. In system X, subsystem standard 1 has evolved into a system standard and now connects established subsystems A and B. Subsystem standard 2 could potentially also be used for the interconnection of established subsystems A and B. In system Y, a system standard connects the subsystems. To determine whether a standard can be categorized as being a subsystem or a system standard, we will look at the original purpose of the standard. When the standard was originally developed for home networking, it is categorized as a system standard. When it was originally developed for one particular subsystem within the home network it will be categorized as a subsystem standard.

3. Converging worlds

The home network market consists of different product markets that are converging with each other. Each product market consists of its own technologies, subsystems, and standards. Standards that originate from one product market may potentially be used to realize communication in the complex system and must therefore also be taken into account in this analysis. This increases the total amount of standards even more. We will distinguish four basic product markets: information technology (including hardware and software), consumer electronics, telecommunications, and home automation [9,10].

The information technology product market is characterized by products that have a PC architecture and a generic (Intel, AMD, etc.) processor. There is a fair amount of standardization of communication protocols and accessories (storage, printers, etc.) but little standardization of operating systems and applications (since the market is arguably an oligopoly dominated by Microsoft with Apple and Linux

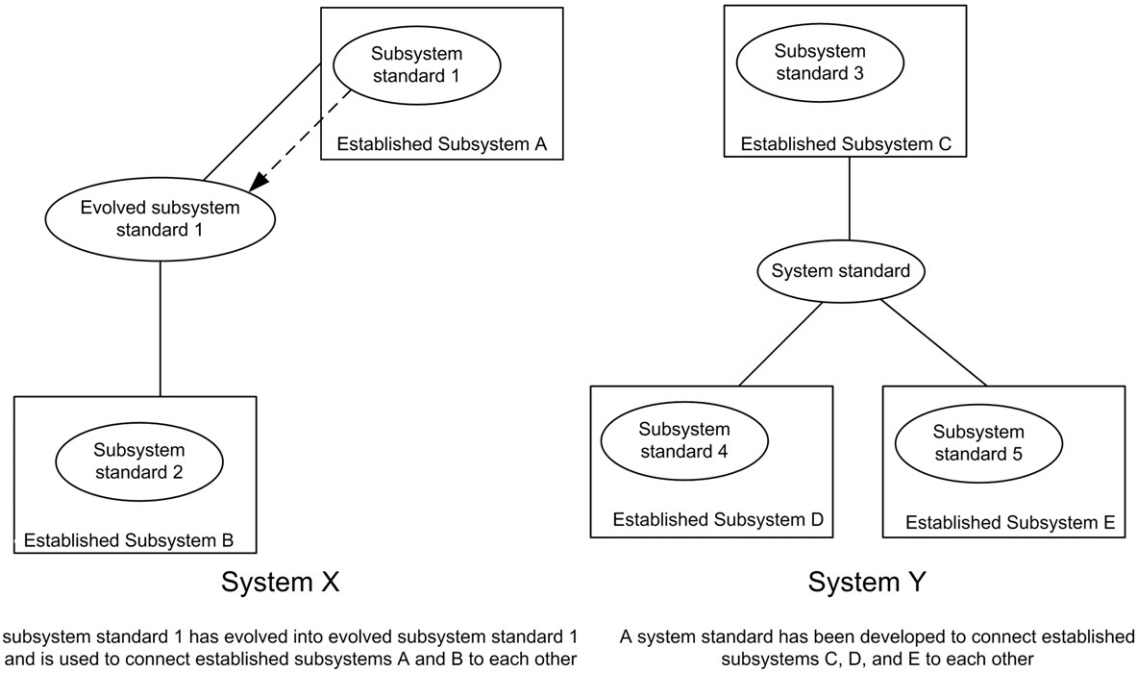

Fig. 2. System, subsystem, and evolved subsystem standards.