

Integrated Multimedia and Sensor Data Management in Heterogeneous Home Networks: a Concept Proposal

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Abstract—Home Area Networks designed for the delivery of both multimedia contents (e.g. TV programs, movies, music) and home automation services (e.g. household appliances commands, lighting and surveillance controls) are becoming widespread, especially thanks to the latest developments in wireless sensor and communication devices. This kind of networks, however, represents a new challenge for the networking field, particularly with respect to the integration of many different home and building automation solutions, that are not originally conceived to coexist and exchange data. Consequently, it is necessary to introduce an operational infrastructure able to interconnect different devices on the same communication link, or over different links, by means of a single user interface and a unified intelligence, thus making possible a complete and efficient management of the system. This paper outlines the main components in the design of an integrated home network architecture based on both commercial and customized devices developed ad-hoc, and provides preliminary results about the performance obtainable in the delivery of different data flows. The convergence of many differentiated services over IP-based architectures dramatically increases the amount of IP traffic to be delivered to the clients, so that Quality of Service management issues arise, and are to be taken into account.

Index Terms—Home Area Networks, sensor, multimedia, integrated management.

I. INTRODUCTION

THE definition of Home Area Network (HAN) refers to a network located and limited within a single house, and at present, given the dominating trend, it translates into an IP-based network covering the whole premise, and conveying all kinds of user services [1]–[3]. Modern houses are requested to be equipped with digital control systems for functional services, like household appliances, lighting and surveillance. Moreover, digital entertainment contents are expected to be available in each single room, such as, for example, digital radio and television services, personal movie and music collections, and others. In addition, Internet-based communication services, such as IPTV and Voice over IP, are becoming widespread, so broadband connectivity is now an ubiquitous requirement. All this pushes to design solutions able to convey many differentiated services over IP-based networks, with favorable cost to benefit ratios [4], [5]. Among the several research activities promoted in the field of HANs for media delivery, the European project OMEGA [6], [7] is investigating

a possible hybridization of network technologies for future entertainment services, through the design of a so-called Inter-Medium Access Control (MAC) layer. Many efforts have been made to converge heterogeneous physical technologies into a single coherent framework, but no impacting solutions have been achieved up to now. The targeted architecture is a Gbps-capable home network, necessary to ensure the Quality of Experience expected by the user, built upon radio links combined with a Power Line Communication (PLC) - based backup infrastructure, in such a way as to not require any “new wires” within the home.

Besides entertainment services, home automation facilities represent a fundamental requirement for modern buildings and houses. Many standards have been released for the exchange of home automation data, as, for example: European Installation Bus (EIB), European Home System (EHS), Open Services Gateway Initiative (OSGi), Home Audio Video Interoperability (HAVi), and others. Furthermore, industrial protocols can be adapted to fit home automation applications, such as, for example, DeviceNet, Profibus, CAN and RS485 standard protocols. They are conceived for short-distance and low-cost connectivity of sensors and actuators, so they fit well to the context of home networking applications. Any home automation solution has to satisfy some basic requirements to ensure the user’s comfort and trust. Among them: easiness of use, service continuity (i.e. very low failure probability), reliability, and limited costs. Once these goals are satisfied, a properly designed home automation solution may also allow energy saving, besides a comfortable and performing management. The main elements in home automation are sensors and controllers. Sensors monitor different parameters related to the home environment, and translate their variations into correspondingly varying signals. Controllers process signals generated from sensors and user’s configurations, and send proper commands to the actuators located in the home environment.

To convey different data services over IP, such as home automation and multimedia services, gateways must be provided, that adapt automation data transport to IP based networks, and allow an easy management of the connected devices, both from the inside, and from remote networks. Home gateways shall connect the external access network and the internal heterogeneous home network, and deliver services to the home environment. Different consumer hardware platforms may compete against each other to become the selected home

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