ETSI TS 103 425 V1.1.1 (2016-11)

Publicly Available Specification (PAS)
Smart Machine-to-Machine communications (SmartM2M)
Home Gateway Initiative
RD039-Requirements For Wireless Home Area Networks (WHANs) Supporting Smart Home Services

CAUTION

The present document has been submitted to ETSI as a PAS produced by HGI and approved by the ETSI Technical Committee Smart Machine-to-Machine communications (SmartM2M).

Reference

DTS/SMARTM2M-103425

Keywords

gateway, home gateway, intelligent home & building

ETSI

650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - NAF 742 C
Association à but non lucratif enregistrée à la
Sous-Préfecture de Grasse (06) N° 7803/88

Important notice

The present document can be downloaded from:
http://www.etsi.org/standards-search

The present document may be made available in electronic versions and/or in print. The content of any electronic and/or print versions of the present document shall not be modified without the prior written authorization of ETSI. In case of any existing or perceived difference in contents between such versions and/or in print, the only prevailing document is the print of the Portable Document Format (PDF) version kept on a specific network drive within ETSI Secretariat.

Users of the present document should be aware that the document may be subject to revision or change of status. Information on the current status of this and other ETSI documents is available at
http://portal.etsi.org/tb/status/status.asp

If you find errors in the present document, please send your comment to one of the following services:
https://portal.etsi.org/People/CommiteeSupportStaff.aspx

Contents

Intellectual Property Rights

IPRs essential or potentially essential to the present document may have been declared to ETSI. The information pertaining to these essential IPRs, if any, is publicly available for **ETSI members and non-members**, and can be found in ETSI SR 000 314: *"Intellectual Property Rights (IPRs); Essential, or potentially Essential, IPRs notified to ETSI in respect of ETSI standards"*, which is available from the ETSI Secretariat. Latest updates are available on the ETSI Web server (https://ipr.etsi.org/).

Pursuant to the ETSI IPR Policy, no investigation, including IPR searches, has been carried out by ETSI. No guarantee can be given as to the existence of other IPRs not referenced in ETSI SR 000 314 (or the updates on the ETSI Web server) which are, or may be, or may become, essential to the present document.

Foreword

This Technical Specification (TS) has been produced by ETSI Technical Committee Smart Machine-to-Machine communications (SmartM2M), as result of the PAS process for document HGI-RD039 developed by the Home Gateway Initiative.

The Home Gateway Initiative, a non-profit organization closed on June 2016, produced guidelines, requirements documents, white papers, vision papers, test plans and other documents concerning broadband equipment and services which are deployed in the home.

HGI worked on Specifications for home connectivity and Services enablement, in particular to encompass a delivery framework for Smart Home services. The defined architecture includes support for a standard, general purpose software execution environment in the HG (for third party applications), API definitions, device abstraction, and interfacing with Cloud based platforms.

The HGI's methodology ensured that projects undertaken reflected items of strong interest to the Broadband Service Providers (BSPs), as well as brought in opportunities at every stage for vendor input, suggestions and participation.

Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the ETSI Drafting Rules (Verbal forms for the expression of provisions).

1 Scope and purpose of the present document

The use of Wireless Home Area Networks (WHANs) will expand with the advent of Smart Home services to enable energy management, home automation etc. In many scenarios it is appropriate to use a smart home gateway (HG) to connect the devices and various systems in the house (e.g. lighting, thermostats; heating systems and others).

The present document provides guidance on WHAN technologies to companies or fora that are designing or specifying home automation or service systems.

The wireless In-home communication technology normally supports several functions:

- Bidirectional communication
- Pairing of devices with coordinators
- Application layer interoperability

The present document focuses on the first two functions only.

2 References

2.1 Normative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

Referenced documents which are not found to be publicly available in the expected location might be found at https://docbox.etsi.org/Reference.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are necessary for the application of the present document.

[1] IETF RFC 3565: "Use of the Advanced Encryption Standard (AES) Encryption Algorithm in Cryptographic Message Syntax (CMS)".

[2] NIST SP800-22: "A Statistical Test Suite for Random and Pseudorandom Number Generators for Cryptographic Applications".

2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

[i.1] Void.

[i.2] "Wi-fi simple configuration technical specification" Version 2.0.2.

[i.3] HGI-RD008-R3 (2013): "Requirements for Software Modularity on the Home Gateway".

[i.4] ZigBee™ Pro Test Plan - 07-5035 rev 06.

[i.5] ZigBee™ IP Network Test Specification - 12-0227 rev09.

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

Cloud: network of remote servers hosted on the Internet and used to store, manage, and process data in place of local servers or personal computers

Coordinator: device in a WHAN, which (a) converts any commands (or requests for data) from a user or an external agent into data packets, which it routes/transmits to the intended device and which (b) receives data packets from devices and acknowledges, records, or converts the packets into signals for the user or controlling software

NOTE: There is only one coordinator in a WHAN.

Device: piece of hardware that provides connectivity and functionality

Gateway Operator (or just operator): Primary responsibility of the Gateway Operator is to control who is allowed to deploy services to the Service Platform in question i.e. control which Service Deployment Managers are allowed to manage the particular Service Platform. In addition to this, the Gateway Operator can also manage other functions related to a specific Service Platform instance.

Network Provider: Provides and manages wide area network connectivity between the Service Platform and other parties, which include the Gateway Operator and other Service Providers. In the case where the Service Platform is connected via the Internet, the Network Provider also supplies the Internet Service Provider (ISP) functionality.

Remote Controller: device which allows a user to remotely operate another device e.g. switch another device on/off

Response Time: time between the trigger event and the user getting feedback

Service Customer: subscribes to services and pays the charges that are incurred using those services

Service Provider: Is a business entity. The Service Provider supplies the necessary means to provide the business related support of a specific Service Application. The Service Provider is also responsible for delegating the task of service deployment to the Service Deployment Manager.

Smart Home Services: autonomous or software-assisted automation system within the home, for example automation of lighting, security alarm systems, energy management systems, health monitoring and alert systems

Sniffing: successful reading of information by a person (or software) different to the intended recipient(s)

Wireless Home Area Network (WHAN): wireless communication network for interconnecting devices centred around an individual person's workspace or home

3.2 Abbreviations

HG	Home Gateway
HGI	Home Gateway Initiative
WHAN	Wireless Home Area Network(s)

4 Purpose of the present document

4.1 Rationale

Network providers (i.e. telecommunication carriers) have begun developing and deploying Smart Home services. To realize these services, it is useful to work with other industry players such as device manufacturers, service providers and platform operators to develop communities of interest and construct ecosystems for the services. It is necessary to adopt new technologies for low-power wireless communications to enable smart HG functions which often involve battery powered devices. Network providers are not yet in a position to select a single WHAN technology, but whatever is chosen it is expected to provide a good user experience in addition to technical capability and performance.

4.2 Problem statement

Wireless in-home connectivity is an essential element in providing Smart Home services; installing new wiring just for a Smart Home service is usually unacceptable being difficult, costly and aesthetically displeasing. However, although there are many types of wireless technologies available, none can currently satisfy all the user and service provider requirements.

The present document describes the requirements for Smart Home wireless in-home connectivity to indicate the direction in which such technologies need to develop to support both current and future needs.

4.3 Benefits for the industry

The current status of WHAN technologies is hampering the development of the Smart Home market. The lack of a ubiquitous, plug and play wireless technology is a major barrier to mass-market adoption of Smart Home services. None of the operational entities [i.3], from service provider to user, can be sure which technology will become the de facto standard/market leader and so may be reluctant to choose or invest.

4.4 Roles and responsibilities

The **manufacturer** produces equipment for the home, such as sensors, actuators, smart appliances, and other sub-systems (alarm, home automation), and smart HGs. The manufacturer integrates the chipset, software stack, and the application programming interfaces. In some cases, they may also directly produce devices. Some requirements for device certification are usually set by the platform operators and/or service providers.

The **platform operator** manages a Smart Home platform, which includes a smart HG and a WHAN in the home, as well as servers in the Cloud. The platform operator may be a network provider or a gateway operator, e.g. a telecommunication carrier.

The **service provider** builds their services on the Smart Home platform and offers them to resellers or directly to service customers.

Service customers are the people who use the Smart Home services. They obtain the necessary devices from the service provider, platform operator, or even a retail shop. To provide Smart Home services cost effectively, it is necessary to avoid dispatching technicians to each house for initial installation or maintenance. Therefore service customers need to be able to install devices and configure their WHAN themselves, even though they will not be technology experts.

5 Key WHAN attributes

5.1 Installation and configuration of devices

One of the most important elements in driving widespread deployment of user-friendly Smart Home services is that installation and configuration of the WHAN should be very easy. With wireless networks, it is potentially easy to eavesdrop or to spoof, so "man in the middle attacks" shall be prevented especially during the installation procedure. The WHAN shall have easy setup functionality and easy maintenance functions. If only specialists can set up the network, then deployment costs will be prohibitive.

A variety of installation methods is needed to provide an acceptable user experience. Any WHAN system shall support all of the below.

1) **Pre-configured devices:** The devices are configured by the manufacturer or platform operator to automatically connect to the WHAN. Usually such devices can connect only to a pre-configured WHAN coordinator.

2) **Easy local setup:** The devices are configured using an easy-setup mechanism that requires only simple operations, such as pushing buttons on the coordinator and the device near simultaneously (see e.g. [i.2]). Sometimes a customer will also need a step-by-step installation and configuration tool. To make the procedure user-friendly, the same procedure for easy-setup should apply to all devices.

3) **Remote setup:** Installation and configuration of devices is done remotely by a service provider or a platform operator.

A typical customer may not know what devices can be used on their WHAN. Therefore, devices should be sold with appropriate labels, which clearly show compatibility, from a certification organization which provides public access to lists of certified products.

5.2 WHAN performance

5.2.1 Reliable wireless communication

To provide reliable service over the WHAN, service providers need to consider issues affecting wireless performance, such as radio interference and coverage, and also ensure that the WHAN does not send data to the wrong device (e.g. switch on/off the wrong light, or connect to devices in a neighbour's apartment).

For example, the WHAN may be used for turning a room light on and off. In this case, rapid and reliable response is required. So the WHAN needs to support delay sensitive communication. Delay sensitive applications usually require less than a few seconds response time, with some being far more demanding. The WHAN also may be used for sending the accumulated data from a series of measurements, thereby requiring the transfer of significant amounts of data, which could take a considerable time on a slow link. However the impact of this on customer experience may be minimal. The below list indicates the maximum acceptable response time for a variety of actions from the perspective of user experience or the service needs (e.g. for alarms).

a) Light switching and dimming: 300 ms.

b) Switching on/off general: 1 000 ms.

c) Actions where visual feedback is expected by user: 1 000 ms.

d) Sensor values with sudden events (motion sensor, smoke detector): 1 000 ms.

e) Sensor values general: 3 000 ms.

f) For some applications the user might accept longer response time, e. g. heating control. Further, some sensors measure parameters that do not change much in the short-term, like room temperature. Such values might be buffered by the coordinator and not require instant reporting from a sensor. The maximum tolerance for such applications can be significantly higher than 3 000 ms. The present document does not define a maximum response time for such applications.

To transfer data effectively, the WHAN should support reliable communication with the worst-case performance still meeting the customer experience or service needs. Re-transmission is likely to be needed in this low-power, high noise environment. However re-transmissions on a slow or very noisy link may not succeed, or may take too long, and can shorten battery life.

The impact of radio interference, both from and into other systems needs to be considered. The 2,4 GHz band in particular is already used widely in the home by various systems, such as Wi-Fi and Bluetooth. Mobile communication services at various frequencies have also become popular. The WHAN needs to coexist with these systems with the minimum amount of mutual interference. The radio frequency bands used by the WHAN (and even the channels within those bands), should be therefore be selected carefully.

As so many home systems already use the ISM band (2,4 GHz), a less crowded frequency region should be considered for the WHAN, e.g. sub 1 Gigahertz. There are already bands reserved for WHAN use in this frequency region. Use of such frequencies would allow the WHAN to continue to work well even in highly congested Wi-Fi areas.

Coexistence of Wi-Fi and the WHAN shall be possible even when they use frequencies quite close to each other, even when the physical interfaces are in close physical proximity. An interference avoidance function therefore needs be supported by the WHAN to address all these issues. This would make it possible to install multiple networks in one area. In Europe, LTE at 800 MHz may adversely impact the 868 MHz band allocated for WHAN use. If the 868 MHz radio band is used for the WHAN, measures shall be taken to prevent interference from the LTE systems.

Wireless channel selection functions are also required to select the channel subject to the least interference. Interference mitigation techniques are also required to provide a reliable and stable network. These include carrier sensing, dynamic selection of the most suitable channel, and even scheduling functions (e.g. Time Division Multiplexing between Wi-Fi and WHAN).

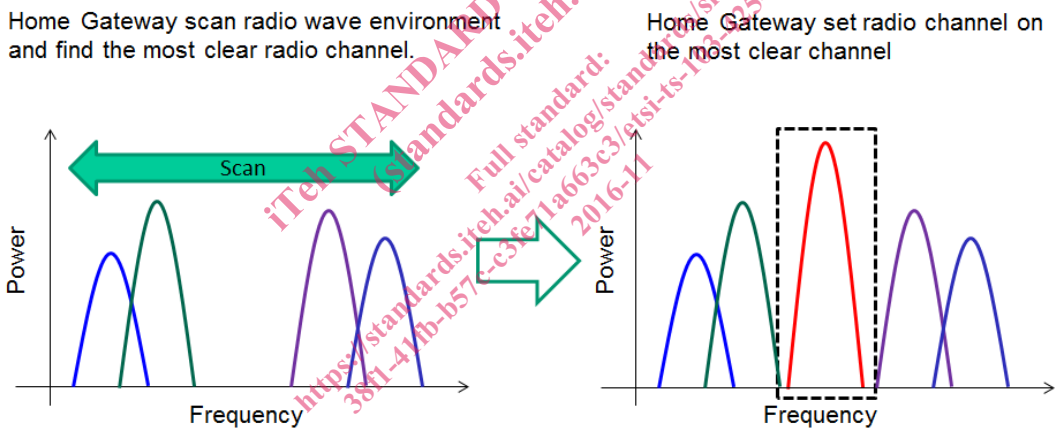

Figure 1: Wireless Channel Selection Function Image

The WHAN should provide reliable operation for many years as WHAN devices may not be replaced very often. Reliable operation shall be maintained even when the user or a neighbour installs additional devices.

The radio frequency and transmit power shall of course comply with the radio regulations in each country.

As for coverage, the WHAN has to cover the whole home. However it may be difficult to achieve this using a direct connection from each device to the coordinator. Therefore some function to extend coverage is required, e.g. repeaters or meshing.

It would be useful for devices to be able to indicate where the radio link performance is acceptable, especially during installation. This will require a low level testing mode.

Smart Home services typically use at least some battery-powered devices, for example remote controllers of home electrical appliances and sensor devices. Typically, home electrical appliances and remote controllers only need to communicate between several and a few dozen times each day. Sensor devices may communicate more frequently, once every several minutes, with metering devices being similar. The WHAN should support this range of occasional operation, thereby enabling long battery-lifetime. The HGI operators expect the following battery life times under normal operation mode:

a) home electrical appliance remote controller: 2 years