VDE ROADMAP

Version 2

GERMAN STANDARDIZATION ROADMAP AAL

(AMBIENT ASSISTED LIVING)

Status, Trends and Prospects for Standardization in the AAL Environment

DKE VDE DIN

VDE

Publisher

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1. PRELIMINARY REMARKS

Ambient Assisted Living (AAL) is a topic that is undergoing constant development. Only a few years ago it was still a separate research and work area, but was then quickly taken up and promoted by numerous national and European players. New prospects, responsibilities and needs emerged and contributed to the overall development. Today it is a highly topical and highly discussed area with comprehensive activities from the national to the European level and recently also on an international scale.

AAL means assistance solutions in the everyday setting for every age and environment, demanding interaction from a large number of partners from a range of different medical, technological, social and business-related areas. Not only is it necessary for the players to show mutual consideration: in addition, the mandatory interaction of different systems and components demands a high degree of adaptability and, above all, interoperability. This also results in a large number of specifications that already exist and are applied to the individual systems today.

However, the mere existence of such specifications does not necessarily live up to the specific requirements of the AAL systems and products. There is a need on the one hand to look at the existing specifications to identify and select those that really offer system relevance. On the other hand, existing gaps have to be closed, particularly as regards integration and interoperability of the individual systems and also as in terms of qualified staff training and quality assurance.

In April 2013, a second AAL Symposium was held to further the development of the first German. Standardization Roadmap. The aim of the symposium was to enhance an understanding between the various players and to offer participants an opportunity to discuss new problems, pronounce requirements and recommendations and to make an active contribution to shaping the second German AAL Standardization Roadmap. Above all, agreement was to be reached on drawing up a timescale and allocating tasks among the various participants.

This Standardization Roadmap enhances the shared understanding of all stakeholders in the AAL environment and makes them more aware of other people‘s issues. The German AAL Standardization Roadmap aims to set the trend and act as the guideline for a more clearly structured AAL environment.

2.1 Framework conditions

Framework conditions
The need for AAL developments results on the one hand from demographic developments and on the other hand from increasing desires for convenience and comfort.

Legal requirements
The highly heterogeneous group of people using AAL systems results in a large number of functional and non-functional user requirements that have to be taken into consideration right from the start. Legal requirements are defined above all by data protection laws and the Medical Devices Act.

Standards and specifications
Ambient Assisted Living is a hybrid product referring to a basic technical infrastructure in the home and services provided by third parties with the aim of continuing to lead an independent life in one's own home. Assistance systems for helping with activities and participation are used in different areas. Various regulatory principles have to be observed in implementing these assistance systems.

2.2 Specifications and standards for AAL

Some (non-)technical areas have relevant standards and specifications for AAL systems and components. However, many project results and opinion surveys revealed that there is still a great degree of uncertainty regarding the selection and use of corresponding standards and specifications.

The first version of the AAL Standardization Roadmap gave recommendations for fostering progress in terms of selecting and using the right standards and specifications as well as establishing widespread dissemination of the ambient assisted living technologies. The following section lists the recommendations from the first German AAL Standardization Roadmap and indicates the results that have been achieved.

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2.3 Recommendations from the first German AAL Standardization Roadmap

International character
To ensure that AAL systems can become established on the European Single Market and beyond, AAL standardization activities should take place on an international or at least European scale.

Application-centered integration profiles
In order to establish cross-vendor interoperability of systems and components, typical AAL systems or applications should be identified and the necessary components, interfaces and data formats etc. should be standardized.

Standards for the interoperability of AAL components
As far as AAL is concerned, there are certain gaps in the current standards collection. These standards should be closed through the creation of corresponding standards by the affected bodies.

Operating AAL systems
In many cases, AAL systems will be used on a cross-provider basis so that ordinances and regulations will be necessary for cooperation and for sharing responsibility between the stakeholders. Where remote management is concerned, consideration has to be given to the fact that separate roles and responsibilities can be involved when operation is shared.

Certification and seals of approval (seals of quality)
Quality assurance certification is necessary for both AAL products and AAL providers.
In addition, a privacy seal of approval is also conceivable for AAL providers.

Definitions
Definitions should be drawn up to promote a uniform understanding of words and phrases being used in the AAL environment. Here reference can be made to the VDE application guide VDE-AR-E 2757-1:2013-05 Ambient Assisted Living (AAL) – Terms and definitions.

Up to now, the following results have been achieved or advanced with regard to the first German AAL Standardization Roadmap:

Advancing AAL standardization activities on the European and international level

- Founding of the IEC/SG 5 (AAL) and taking up activities on the international level.
- Stage 0 Project AAL was founded by the IEC TC 100 and a Technical Report (TR) on AAL is being drawn up.

Identifying prototypical use scenarios in order to standardize the necessary components, interfaces, data formats etc.

- Initial use scenarios have been identified (in the form of integration profiles) and a formalistic visualization has been elaborated.

Analyzing and listing gaps in existing standards in the AAL environment. Swiftly applying for and implementing necessary standards and specifications for interoperability of AAL components.

- Standards have been analyzed and AAL has been introduced in various bodies.
- Corresponding bodies have been identified and made familiar with the AAL issue.

Advancing the certification and awarding of test seals for AAL service providers and defining systematic processes for developing AAL products.

- Initial activities are being developed for certifying and awarding test seals to AAL service providers.

The second German AAL Standardization Roadmap consolidates previous results, while the trendsetting nature of the document provides further support for the pronounced recommendations. New problems and requirements have emerged in the course of development so that the Roadmap pronounces new demands and recommendations which are listed below.

2.4 Recommendations of the second German AAL Standardization Roadmap

The following recommendations have emerged from the second German AAL Standardization Roadmap. AAL must be illuminated on a multidisciplinary level with an approach that is international in as many aspects as possible. It is therefore appropriate to establish international or at least European standards for AAL so that incompatible national standards do not inhibit the introduction of AAL systems on the European Single Market (and beyond).

An equivalent to the IEC/SG 5 is to be set up on the ISO side.
An international steering unit is needed on the ISO side, corresponding to the IEC/SG5 AAL for the longer term joint strategy for specific AAL standardization and for the interoperable AAL environment.

Clear distinction between AAL advisers and AAL carers.
A clear distinction should be made between the various people involved in AAL and their various tasks.

The range of skills of the players should be extended.
There is a need to extend the skills of the AAL players. It is therefore necessary to define further training possibilities and additional qualification opportunities.

All in all, these components are necessary for producing the second German AAL Standardization Roadmap and form the basis for all further standardization activities.

3 INTRODUCTION AND BACKGROUND

Current forecasts indicate that as a result of demographic change, by 2035 half of the German population will be aged 50 years and older. As a result, there will be a constantly growing demand for ambient assisted living systems to provide support and assistance among others for everyday activities in an unobtrusive fashion according to the particular situation. There will an extensive merger of technical and social systems, leading to greater use of information and communication technology as part of everyday life. Vital signs and ambient data will be registered by sensor systems kept on or near the body and distributed throughout the room. Technology used in the AAL environment can be modular and networked for adapting to individual needs and the individual setting and to offer optimum assistance by having an integrated view of the available data.

The population using such systems forms a heterogeneous group. It includes both healthy and active people who use lifestyle functions mainly to enhance their quality of life, through to patients with multiple morbidity and disabilities in order to make it possible for them to remain living on their own in their home environment for longer. As a result, different groups associate different AAL with different kinds of service.

3.1 Framework conditions

3.1.1 Social framework conditions – population projections

Population projections make it possible to depict and analyze future changes in the age structure of the population. An analysis of the corresponding results permits statements about population development over a period of time; at the same time, it is possible to compare the demographic development of different countries.

Population projections are based on a macro-simulation by the Federal Statistical Office that includes certain factors and develops the statistics in consideration of these factors. The total population is divided according to year of birth and gender; this is then updated from year to year according to age and gender-specific transition probabilities or frequencies. The factors involved in the updating process consist in demographic parameters such as the birth rate, death rate and migration.

Given that the actual development of the key parameters is not known over the long period of population projections, as a rule several assumptions are made regarding the course followed by the individual components. The combination of assumptions then results in differing variations in population projection. The results of a projection may therefore always only be interpreted in the context of the respective assumptions [1].

Table 1 – Population details at a glance

Detail	Year	Quantity
Population (31.12.)*	2012	80,5 Mio.
Live births	2012	673 570
Death	2012	869 582
Migration balance	2011	+279 207
Private households	2012	40,7 Mio.
Families with underage children	2012	8,1 Mio.
Share of foreigners (31.12.)*	2011	7,9 %
Population with migration background	2011	19,5 %

* Population figures based on the 2011 census 2011 [1]

3.2 Legal requirements

Legal requirements exist for example with regard to data protection and informational self-determination, as well as the Medical Devices Law.

3.2.1 Data protection and informational self-determination

AAL technologies and the related services handle large quantities of sensitive data. For example, these include details of the patient's vital signs, data about social contacts, domestic activities and sickness data. Some of these areas are already covered by legislation, e.g. patient-related data processing. In this respect, EU directives must be consulted (Directive 95/46/EC, [2]) together with national implementation on the federal scale (Federal Data Protection Law, [3]) and on the level of the individual states (State Data Protection Laws [1]). Other relevant legislation is contained in the German Criminal Code and in the Social Code [4]. Under certain circumstances compliance with other laws is necessary for data going over and beyond health data, including for example the telecommunications law [5].

Further legislation is also being discussed for AAL applications as defined e.g. by Dix [6]

- The needy and elderly must not be deprived of their rights or told what to do (today: those under legal supervision, formerly: those under guardianship),
- Principle of data prevention and data economy,

1 A list of all State Data Protection Laws can be found in [62]

- Freedom to choose between central (cloud-based) and local data storage, e.g. in user's computer and storage of medically relevant data with the attending doctor
- Privacy by design,
- Data flows should be transparent and controllable where possible,
- System functions should be transparent,
- Self-determination must be upheld, i.e. if people decide not to use the technology, this decision must be accepted and they must not suffer any drawbacks as a result.

As far as data protection is concerned, special requirements are being discussed for IT infrastructures (such as a possible AAL infrastructure for example). Corresponding test questions are discussed for example by Hansen/Thomsen [7], defining the following among others for life-long data protection infrastructures:

- Viable planning and assurance of human and financial resources,
- Operating models and procedures for operational transfer,
- Warranting data protection and data security for future developments and also past periods,
- Verifiability of data protection and data security measures including defining the anticipated results,
- Regular review of the data protection and data security measures,
- Use of current certification measures and/or development of new ones,
- Establishing a process for on-going risk analysis.

There is a need to clarify the distinction between data protection and data security. Prior to data protection, clear data security concepts have to be stipulated already in the development phase. Furthermore, data protection has to be integrated in all processes implemented by the vendors and service providers.

More work in this field is currently being carried out among others by the ULD (Independent State Centre for Data Protection) in Schleswig-Holstein (ULD). The ULD produced the pilot study „Legal issues relating to age-appropriate assistance systems" as part of parallel AAL research. Abstract models are used to identify the existing legal relationships between stakeholders, analyzing the data flows and handling processes and deriving resulting legal issues. Furthermore, international data protection specifications are currently being compiled by ISO working groups.

High security requirements are vital for a successful AAL environment. It is important for security-related issues to be defined in the very early phases of development and to set up a security architecture in the AAL environment.

2 Project finished October 2010, results see [63]

3.2.2 Medical Devices Law (MPG)

All assistance systems are governed by standards for general safety as explained in greater detail in sections 4.1.1 and 4.6.3. However, special provisions apply to all products used for the „… recognition, prevention, monitoring, treatment and alleviation of illnesses, …. or injuries or disabilities, ….or the examination, replacement or changing of the anatomical structure or a physiological process …“, (Section 3 (1) Medical Devices Law). Assistance systems with such properties are considered to be medical devices and are governed by the scope of the MPG. They are directly related to the diagnosis, therapy and rehabilitation of functional restrictions (pursuant to ICF, b1…bx or s1…sx) or illnesses.

Specific methods and workflows have to be applied to these systems to achieve currently feasible safety, efficiency and reliability. The following apply in this case:

- Usability engineering (DIN EN 62366),
- European directives (e. g. 93/42/EEC),
- National legislation (e.g. Medical Devices Law)
- National ordinances (e.g. Medical Devices Safety Plan Ordinance (MPSV), Ordinance on Clinical Trials of Medical Devices (MPKPV),
- International and national standards (EN, DIN, VDE, etc.,
- Quality assurance (DIN EN ISO 13485).

Due consideration also has to be given to other regulations with a broader scope (see Section 2 (4) MPB, e.g. Emergency Call Ordinance). The vendor of such systems is responsible for proceeding with the conformity assessment procedure for a medical product so that the product is subsequently awarded the CE mark. If he consults a private-sector test body (so-called Notified Body) this mark includes a four-digit identification number. Among others, this also includes classification of the medical device (pursuant to Annex IX of Directive 93/42/EEC) and verification of compliance with the essential requirements made of medical devices (Annex I of 93/42/EEC). This can be verified by applying harmonized European standards (EN) (see Section 8 (1) MPB). The vendor of medical devices in higher risk classes must ensure that a quality assurance system (DIN EN ISO 13485) was implemented for the design, production and final control of the respective products. Figure 1 shows the procedures for CE marking of medical devices according to the classification. The application guide VDE-AR-E 2750-200 “Approach to the classification of medical devices and the selection of conformity assessment procedure“ can be used to classify medical products.

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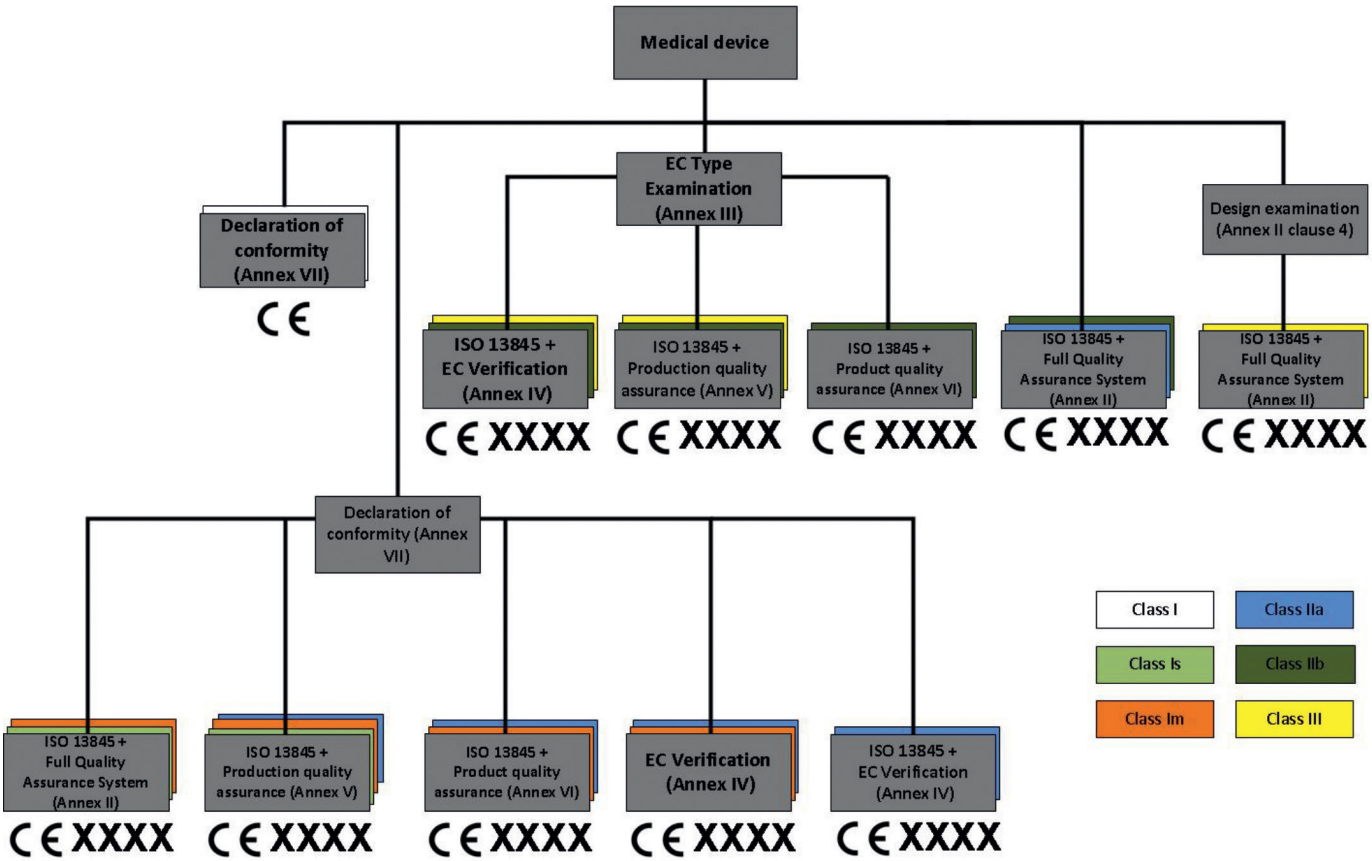


Figure 1 – Procedures for CE marking of medical devices according to classification [8]

verification of compliance with the essential requirements made of medical devices (Annex I of 93/42/EEC). This can be verified by applying harmonized European standards (EN) (see Section 8 (1) MPB). The vendor of medical devices in higher risk classes must ensure that a quality assurance system (DIN EN ISO 13485) was implemented for the design, production and final control of the respective products. Figure 1 shows the procedures for CE marking of medical devices according to the classification. The application guide VDE-AR-E 2750-200 “Approach to the classification of medical devices and the selection of conformity assessment procedure“ can be used to classify medical products

- Operators, e.g. hospitals
- Users, i.e. all medical care professionals using a medical device,
- People authorized by the user, e.g. to provide instructions for using new medical devices with a high level of potential risk.

The obligations of users and operators include:

- Keeping a stock list of all active non-implantable medical devices,
- Keeping medical device logbooks,
- Regular controls of the devices,
- Providing users with instructions in how to use the medical devices correctly,
- Reporting malfunctions and failures of medical devices that have been, could have been or
- could be the direct or indirect cause of the death or major deterioration in the health of a patient, user or other person, (see MPSW) and
- Preparing medical devices that are used in sterile or virtually sterile state for their intended purpose, i.e. assuring the “Hygiene requirements in the preparation of medical devices” (so-called RKI recommendations) [9].

3.3 Standardization

3.3.1 Structure of the standardization landscape

The structure and relationships involved in the standardization landscape were already described in the first German AAL Standardization Roadmap [10].

3.3.2 DIN, CEN and ISO

DIN, the German Institute for Standardization, offers stakeholders a platform for the development of standards and specifications as a service to industry, the state and society as a whole. DIN is a private organization with the legal status of a non-profit association. Its members include businesses, associations, authorities and other institutions from industry, commerce, trade and science.

DIN‘s primary task is to work closely with its stakeholders to develop consensus-based standards that meet market requirements and the particular timeframe. By agreement with the German Federal Government, DIN is the acknowledged national standards body that represents German interests in the European and international standardization organizations.

Almost 90% of the standards work carries out by DIN is European and/or international in nature. The members of staff at DIN organize the whole process of non-electrotechnical standardization on the national level, with the corresponding national bodies safeguarding German participation on the European and international level. DIN represents Germany‘s standardization interests as a member of CEN and as a member of ISO.

3.3.3 DKE, CENELEC and IEC

The DKE German Commission for Electrical Electronic & Information Technologies of DIN and VDE is a modern, non-profit service organization promoting the safe and rational generation, distribution and use of electricity serving the interests of the general public.

The DKE's task is to develop and publish standards in the fields of electrical engineering, electronics and information technology. The results of DKE work are published as DIN standards and thus form an integral part of the German standards collection. Where they contain safety provisions, they are also published as VDE specifications and are included in the VDE Specifications Code of safety standards.

The DKE represents the interests of the electrical/electronic engineering and information technology sectors in international and regional electrotechnical standardization. It is a joint organization of DIN German Institute for Standardization and the VDE Association for Electrical, Electronic & Information Technologies with the VDE being responsible for the DKE's daily operations. The DKE is responsible for the standardization work that is dealt with in the corresponding international and regional organizations (IEC, CENELEC and ETSI). It represents German interests both in CENELEC and in the IEC.

Objectives of the DKE

- **Safety**
  Overall safety for electrotechnical products and installations, as well as their related services, and labour protection
- **Compatibility**
  System compatibility of products and installations in networked systems and applications
- **Market orientation**
  Accelerated diffusion of new technologies on the market by supporting information processes via standards and specifications
- **Consensus building**
  Bringing together the knowledge and the interests of all associated parties, building consensus even around controversial technical issues
- **Representation of interests**
  VRepresenting German interests in the development of international and European standards, in order to eliminate obstacles to trade and to open markets worldwide
- **Quality**
  Maintaining a high level of up-to-date technical rules in a consistent and widely accepted portfolio of standards oriented towards market and consumer requirements

- **Conformity assessment**
  Worldwide acknowledgement of conformity assessment results

DKE working bodies are German „mirror committees“ of the relevant IEC (or CENELEC) Technical Committees so that only one single German body is responsible for all national, European and international work and/or cooperation in the respective specialist area.

3.3.4 IEC/SMB/SG 5 „Ambient Assisted Living“

The IEC/SMB meeting in October 2011 decided to set up the Strategic Group 5 Ambient Assisted Living (SG 5 AAL) on the IEC level. The SG 5 AAL was founded with the intention of coordinating and leading standardization activities within the IEC Technical Committees (TC) and to issue recommendations for establishing interoperability and interconnectivity of AAL systems.

3 specific groups were set up to analyze the whole AAL setting. A status update is elaborated for standards together with the TCs and SCs (subcommittees) affected by AAL in order to analyze possible gaps in the standards and in the needed committees.

There is also a group looking into the minimum requirements for data security. It transpired that data security is hard to define in the global context. Consideration has to be given to a great many different regional regulations so that it will be difficult to fulfil a global definition. As a result, the conditions for data security and privacy have to be kept general with regional amendments. Electrical safety and reliability are already firmly established at the IEC which will make it easier to draw up the corresponding requirements for the AAL environment.

The third group deals with use cases which are analyzed and classified using a model. The use case model which is based on the use case model developed by another strategic group – SG 3 Smart Grid Reference Architecture [3] – classifies a use case example in different levels. These are analyzed in terms of component functionality and interoperability. The model also permits the allocation of required standards and specifications as well as respective committees.
The use case model does not define any reference architecture, nor can it assess any corresponding application.

3 see the Grid Reference Architecture report by the CEN-CENELEC-ETSI Smart Grid Coordination Group [64]

3.3.5 Producing standards

Certain principles have to be fulfilled in order to produce a standard (see Table 2). If the principles have been heeded and the standard compiled, the proposal for standards work is submitted for review by the respective committee. Once approval is given, a draft proposal is compiled and adopted on completion. It then acts as the basis for producing, reviewing and publishing a manuscript for the draft standard. This is followed by an objection period during which anyone can submit comments on the draft. The body then discusses the submitted opinions; under certain circumstances, extensive objections may make it necessary to produce a second draft standard. Otherwise the comments are processed accordingly so that a final version of the standard can then be adopted.

The manuscript goes through another review before producing a control proof, after which the standard is included in the German standards collection and published.

Specifications differ from standards and do not have the de jure status of a standard. Specifications are developed and published by many different bodies. The word „standard“ is frequently used with different meanings. This is because the English „standard“ is the direct equivalent to the German word „Norm“, while the German word „standard“ means a de facto standard in English. In contrast to standardization, specifications do not have to take account of all ten principles. As long as a specification does not go through a public objection process, the „everyman principle“ for example and public consensus building have limited relevance (see table 2, „Specification“ column).

Table 2 – Attributes of standards and specifications in comparison

	Principle	Standard	Specification
1.	**Voluntary**	X	X
2.	**Public**	X	
3.	**Everyman principle**	X	(X)
4.	**Uniform and consistent**	X	X
5.	**Relevant**	X	X
6.	**Consensus**	X	(X)
7.	**State of the art**	X	X
8.	**Geared to prevailing economic conditions**	X	X
9.	**Geared to general benefit**	X	X
10.	**International**	X	

X relevance (X) limited relevance

3.3.6 Preconceived ideas about standardization

Standards and specifications are taken for granted on an everyday basis and frequently used without knowing what they actually entail. There are also many preconceived ideas about standardization. It is generally presumed that standardization „only affects big business“, resulting in ignorance about the rules for producing standards so that many claim that the regulations and formal approach are too complicated.

One frequent criticism is that standardization takes too long on account of the many stakeholders involved and the resulting consensus process. However, specifications can be used as a pre-standardization document, providing a tool for accelerating the process.

3.3.7 Benefit of innovative AAL technology and corresponding standardization

The AAL environment will be a central innovation area over the next few years. On the one hand, the (technical) support of those in need of help is a challenge with relevance for the financial future of the health system. On the other hand, the innovative development of systems and system components is an economic challenge, as the technology has to be both profitable and also applicable for the final consumer. Standards and specifications have to cover these aspects and technology-convergent issues in order to provide the corresponding bodies with a basis for further discussions with the professional community.

Various interest groups profit in different ways from AAL systems and from standardization in this sector. The aim must be in particular to integrate these various interest groups and to use their expertise to take up innovations at an early point in time so that corresponding work results can be made quickly available. A heterogeneous body is indispensable for standardization to allow for adequate elaboration of the differing aspects in the AAL environment. Here the multiple assessor approach ensures all professional aspects are covered so that the standard will be a reliable product that lets the results flow into the broad market. The standards have to be supplemented in line with the market and general demand.

The planning and development of AAL system components demands a high level of commitment by the stakeholders. This entails not only declaring simple, clearly structured AAL conditions but also defining links with other legislation (Medical Devices Law or Data Protection Law). These framework conditions can be described in the form of standards and specifications and make a major contribution to the development of the AAL environment.

3.3.7.1 Standardization and specification create markets

For AAL to become accepted on a broad basis, due consideration has to be given to both individual requirements and to flexibility. This refers in particular to making use of accustomed devices and to expanding the AAL system with economically profitable technology. The costs of the system components are a crucial factor for acceptance among manufacturers and final customers and thus also for marketability. These costs can be reduced not just through innovations but also to a great extent through the economies of scale. Standardization can help to lower trade barriers and open the global markets for products, innovations and services.

Standardization work is significant in particular for the following aspects:

- The wide range of requirements made by a heterogeneous group of users demand high interoperability and compatibility of the individual components in any AAL system.
  The required interoperability of components necessitates detailed analysis of loopholes in the regulations with explicit standardization work.
- Comprehensive safety for the user must be warranted by generally accepted rules and test methods with objective corresponding verification.
- The distribution of technical innovations must be accelerated by top quality advice in the AAL environment together with a professional approach to dealing with AAL systems and system components by developing new job profiles. Only qualified personnel can safeguard the necessary knowledge transfer.
- Instead of developing special AAL systems, preference must be given on a broad scale to upgrading standard products and systems with AAL components.

3.3.7.2 Developing the AAL standardization landscape

Given the increased need for standardization, the DKE‘s Standardization + Innovations division has set up 12 working groups to deal with AAL issues. Figure 2 shows an overview of existing AAL working groups.

The Steering Group AAL supports technical developments (e.g. interoperability), steers and coordinates various DKE standardization projects in the field of ambient assisted living and supports the ongoing sharing of information between professional experts and the working groups. The Steering Group AAL is also responsible for coordinating and reconciling the standardization activities of various standardization organizations (e.g. DIN) and active groups.

The „Basic principles and terminology“ working group deals with the review and further development of terminology and definitions in the AAL field. The working group has revised the specification VDE-AR-E 2757-1 (Terms and definitions); a new version was completed in May 2013.

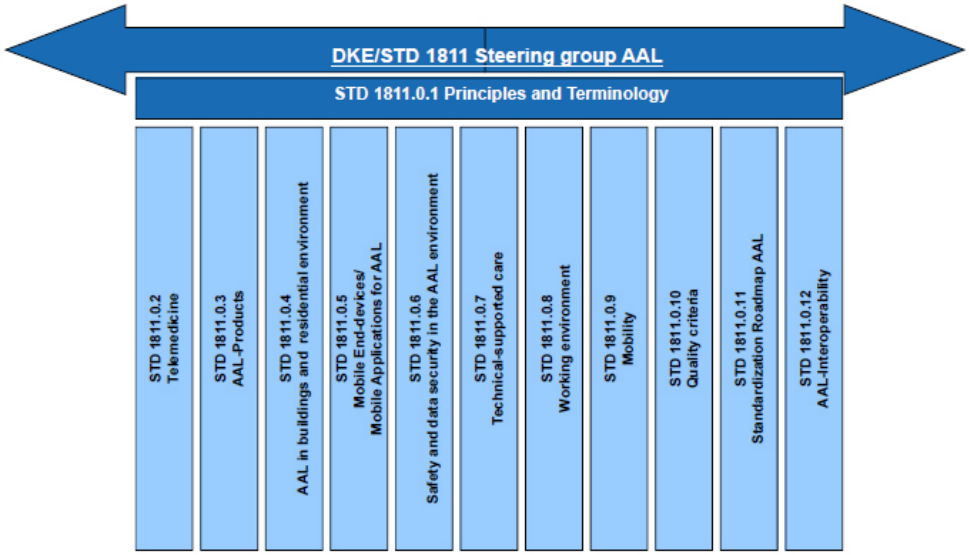


Figure 2 – Overview of the AAL working groups

The „Telemedicine“ working group deals with the field of medical and nursing care together with lifestyle management where it looks at stipulating the requirements for products and services (particularly the scope of service and exchange of information), giving particular consideration to interoperability and usability in the domestic environment.

The „AAL products“ working group is producing a guideline for the development of AAL products together with an internet database for AAL products and offers.

The „AAL in buildings and the living environment“ working group deals with the features and requirements made of assistance processes in order to implement AAL in buildings and the living environment. It elaborates different features and processes for setting up and qualifying an assistance environment for assisted living that have to be taken into account by a system integrator or technical service provider. Here the focus is on depicting the building prerequisites and requirements made of assistance processes for an AAL environment and also made of installations.

The „Mobile terminal devices/Mobile applications for AAL“ working group looks at the various standards and specifications dealing with mobile terminal devices in order to introduce standard power supply solutions together with measuring and testing procedures. Together with harmonization activities, quality criteria are stipulated for the smart mobile sector, as well as analyzing various applications (apps) for the AAL environment.

The „Safety and data protection in the context of AAL“ working group deals with information security and privacy where AAL is concerned. This also includes the fail-safe reliability of AAL systems and their risk appraisal. Furthermore, consideration is given to possible repercussions from AAL systems on connected components and systems (e.g. critical infrastructure).

The „Ambient assisted care“ working group views technical improvements and analyses the feasibility of care and support processes in the domestic environment.

The „Work environment“ working group looks at the aspects of support and assistance in the work environment.

The „Mobility“ working group produces examples and use cases for process chains in the mobility context.

The „Quality criteria“ working group is currently stipulating the requirements in terms of qualifying those working in the AAL field (local AAL contacts, „carers“ as per VDE-AR-E 2757-2, AAL professionals and experts, AAL managers and system integrators.

The „Standardization roadmap“ working group updates the AAL standardization roadmap.

The „AAL interoperability“ working group was involved in producing an update to the first volume published in 2010 of „Interoperability of AAL system components, part 1: state of the art“.
A second volume entitled „Guidelines for interoperable assistance systems - from scenario to requirement“ has been produced in cooperation with the RAALI project funded by the BMBF and was published in June 2013.

Volumes 1 and 2 document existing standards and interface specifications together with approaches to safeguarding interoperability in the AAL environment and define concrete recommendations for the political sector, industry, research and users.

This working group also looks at use cases and integration profiles and produces corresponding guidelines on this topic

4 SPECIFICATIONS AND STANDARDS FOR AAL

The following section provides an overview of all standards and specifications referring to AAL systems and their components. Loopholes in the existing standards collection are analyzed and detected and can be closed using the Standardization Roadmap. Furthermore, recommendations are given for further standardization activities. The standards listed in this Standardization Roadmap act as a guideline for the sectors involved in the AAL environment.

4.1 Sensors/actuators and electrical installation buses

4.1.1 Safety and electromagnetic compatibility

There are very many sensors and actuators that can be used in AAL systems. Most of these components (at least at present) have not been developed specifically for AAL.

The following list is to be seen as an example. The full list of relevant harmonized standards for general product safety is to be found in [11] and the list of relevant harmonized standards for the safety of electrical devices is to be found in [12]. Unless explicit reference is made to individual parts of a standard, the whole standards series is meant in each case.

- **DIN EN 957** Stationary training equipment
- **DIN EN 41003 (VDE 0804-100)** Particular safety requirements for equipment to be connected to telecommunication networks and/or a cable distribution system
- **DIN EN 50106 (VDE 0700-500)** Safety of household and similar electrical appliances - Particular rules for routine tests referring to appliances under the scope of EN 60335-1
- **DIN EN 50194 (VDE 0400-30)** Electrical apparatus for the detection of combustible gases in domestic premises
- **DIN EN 50364 (VDE 0848-364)** Limitation of human exposure to electromagnetic fields from devices operating in the frequency range 0 Hz to 10 GHz, used in Electronic Article Surveillance (EAS), Radio Frequency Identification (RFID) and similar application
- **DIN EN 50491 (VDE 0849)** General requirements for Home and Building Electronic Systems (HBES) and Building Automation and Control Systems (BACS)
- **DIN EN 60065 (VDE 0860)** Audio, video and similar electronic apparatus - Safety requirements
- **DIN EN 60335 (VDE 0700)** Safety of electrical appliances and machines for household environment and similar purposes
- **DIN EN 60598 (VDE 0711)** Luminaires
- **DIN EN 60730 (VDE 0631)** Automatic electrical controls for household and similar use
- **DIN EN 60947 (VDE 0660)** Low-voltage switchgear

- **DIN EN 60950 (VDE 0805)** Information technology equipment - Safety

Furthermore, consideration must be given to standards for safety and hazard warning systems, including the following standards for example:

- **DIN VDE 0833 (VDE 0833)** Alarm systems for fire, intrusion and hold-up - Part 4: Requirements for voice alarm systems in case of fire
- **DIN VDE 0834 (VDE 0834)** Call systems in hospitals, nursing homes and similar institutions
- **DIN VDE 0826 (VDE 0826)** Surveillance systems

In addition, electromagnetic compatibility (EMC) standards must be heeded; here a series of specific product and test standards applies in addition to the generic standards as per DIN EN 61000-6. A complete list of the standardized standards is to be found in [13]:

- **DIN EN 50130-4 (VDE 0830-1-4)** Alarm systems - Part 4: Electromagnetic compatibility - Product family standard: Immunity requirements for components of fire, intruder and social alarm systems
- **E DIN EN 55013/A1 (VDE 0872-13/A11)** and DIN EN 55020: Sound and television broadcast receivers and associated equipment
- **DIN EN 55014 (VDE 0875)** Electromagnetic compatibility - Requirements for household appliances, electric tools and similar apparatus
- **DIN EN 55015 (VDE 0875-15-1)** Limits and methods of measurement of radio disturbance characteristics of electrical lighting and similar equipment
- **DIN EN 61547 (VDE 0875-15-2)** Equipment for general lighting purposes - EMC immunity requirements (IEC 61547:2009)
- **DIN EN 55022 (VDE 0878-22)** Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement
- **DIN EN 55024 (VDE 0878-24)** Information technology equipment - Immunity characteristics - Limits and methods of measurement
- **DIN EN 60601-1-2 (VDE 0750-1-2)** Medical electrical equipment - Part 1-2: General requirements for basic safety and essential performance - Collateral standard: Electromagnetic compatibility - Requirements and tests (IEC 60601-1-2:2007, modified)
- **DIN EN 60601-1-11 (VDE 0750-1-11)** Medical electrical equipment - Part 1-11: General requirements for basic safety and essential performance - Collateral standard: Requirements for medical electrical equipment and medical electrical systems used in the home healthcare environment (IEC 60601-1-11:2010)
- **DIN EN 60669-2 (VDE 0632-2)** Switches for household and similar fixed electrical installations
- **DIN EN 60730 (VDE 0631)** Automatic electrical controls for household and similar use
- **DIN EN 60947-3 (VDE 0660-107)** Telecontrol equipment and systems - Part 2: Operating conditions; Clause 1: Power supply and electromagnetic compatibility (IEC 60870-2-1:1995)

- **DIN EN 61800-3 (VDE 160-103)** Adjustable speed electrical power drive systems - Part 3: EMC requirements and specific test methods (IEC 61800-3:2004)

Moreover, EMC product and test standards apply to the various house bus systems with cable and cordless connection (see Section 4.1.3), point-to-point connections and networks for networking the components of an AAL system.

4.1.2 Point-to-point connections and networks

The components of an AAL system are networked by point-to-point connections (usually bit serial) or by cable or cordless networks. The main standards for data and communications cables are stipulated in the standards series DIN EN 50288 (VDE 0819) Multi-element metallic cables used in analogue and digital communication, E DIN IEC 61156 (VDE 0819) Multicore and symmetrical pair/quad cables for digital communications and DIN EN 50173 (VDE 0800) Information technology - Generic cabling systems.

At the moment, the following standards and industry standards have practical relevance for point-to-point connections:

- Universal Serial Bus Revision 1.0 specification (USB)
- Universal Serial Bus Revision 2.0 specification („USB“) [15], die Weiterentwicklung des Universal Serial Bus Revision 1.0
- Universal Serial Bus Revision 3.0 specification („USB“) [14], die Weiterentwicklung des Universal Serial Bus Revision 2.0 [15]
- IEEE Std. 1394 IEEE Standard for a High-Performance Serial Bus („FireWire“)
- IEEE Std. 802.11p IEEE Standard for Wireless Access in Vehicular Environments (WAVE)
- ANSI/EIA/TIA-232-F Interface Between Data Terminal Equipment and Data Circuit – Terminating Equipment Employing Serial Binary Data Interchange („RS 232“)

The following standards for cable-connected networks are significant for AAL systems:

- **IEEE Std. 802.3 Information technology –** Telecommunications and information exchange between systems – Specific requirements. Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications (“Ethernet”)
- **DIN EN 50065-1 (VDE 0808-1)** Signalling on low-voltage electrical installations in the frequency range 3 kHz to 148.5 kHz
- **DIN EN 50412-2-1 (VDE 0808-121)** Power line communication apparatus and systems

used in low-voltage installations in the frequency range 1.6 MHz to 30 MHz

- **ISO/IEC 14543-3-5 Information technology –** Home electronic system (HES) architecture – Part 3-5: Media and media dependent layers – Powerline for network based control of HES Class 1 („Powerline Communication“)
- **DIN EN 60794 (VDE 0888)** Optical fibre cables
- **VDE-AR-E 2800-901 Informationstechnik –** Information technology – Broadband communication – Fibre-to-the-Building (FTTB) and Fibre-to-the-Home (FTTH)
- **CLC/TR 50510 Fibre optic access to end-user –** A guideline to building of FTTX fibre optic network
- **DIN EN 55024 (VDE 0878-24)** Information technology equipment
- **E DIN EN 50407-2 (VDE 0819-407)** Multi-pair cables used in high bite rate digital access telecommunication networks
- **DIN EN 60950-1 (VDE 0805-1 Beiblatt 1)**) Safety aspects for xDSL signals on circuits connected to telecommunication networks – (DSL: Digital Subscriber Line)

The following standards and industrial standards for cordless networks are relevant for networking AAL components in the close range:

- **IEEE Std. 802.11 Information technology –** Telecommunications and information exchange between systems – Local and metropolitan area networks-Specific requirements – Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications („WLAN“)
- **IEEE Std. 802.15.4** Information Technology – Telecommunications and Information Exchange Between Systems – Local and Metropolitan Area Networks Specific Requirements – Part 15.4: Wireless Medium Access Control (MAC) and Physical Layer (PHY) Specifications for Low-Rate Wireless Personal Area Networks (LR-WPANs) sowie beispielsweise darauf aufbauend die ZigBee Specification [16], [17] („ZigBee“) oder ANT+ [18]
- **IEEE Std. 802.15.1** Information Technology – Telecommunications and Information Exchange Between Systems – Local and Metropolitan Area Networks – Specific Requirements – Part 15.1: Wireless Medium Access Control (MAC) and Physical Layer (PHY) Specifications for Wireless Personal Area Networks (WPANs) („Bluetooth“)
- **Draft ETSI EN 300 175-1** V25.5.0 Digital Enhanced Cordless Telecommunications (DECT)
- EnOcean Equipment Profiles [19] („EnOcean“).
- Z-Wave [20], a wireless communication protocol developed by the Z-Wave Alliance for home automation and in direct competition with ZigBee
- IP500®, a wireless solution for building automation with a focus on safety- and security-relevant applications such as fire, break-ins, access, etc.
- Near Field Communication (NFC) is a contact-free interface technology standardized pursuant to ISO/IEC 18092 and 21481.

The following standards and industrial standards for cordless networks are relevant for networking AAL components in the long range:

- **GSM [21]** is a specification for fully digital mobile radio networks used mainly for telephony but also for line- and packet-switched data transfer and SMS texting. Standardization began with CEPT, was continued by ETSI and subsequently handed over to 3GPP. Here GSM is undergoing further standardization under the name GERAN (GSM EDGE Radio Access Network). 3GPP is therefore responsible for UMTS and GERAN.
- **LTE [22]** is a new mobile radio specification and the future UMTS successor. LTE is a further development of UMTS and HSPA. LTE is increasingly developing mobile radio into an alternative for bridging the last mile, thus constituting an alternative to cable modem technology and DSL.
- **UMTS [23]** is a mobile radio technology for providing multimedia services and is intended to supersede BSM. The technology is based on packet-switched transfer and the internet protocol. It is intended to facilitate effective broadband use to create the prerequisite for new mobile communication services. UMTS was initiated by the European (ETSI) and Japanese (ARIB) standardization organization.
- **WiMAX [24]** is the abbreviation for Worldwide Interoperability for MicrowaveAccess. This is a wireless network standard created in 2002 and approved by the IEEE under the name IEEE-802.16. The aim of WIMAX is to supplya high-speed internet connection over an area of several kilometers. Theoretically, WIMAX can achieve rising and falling transmission rates of 70 Mbit/s with a range of 50 kilometers.

Table 3 – Overview WiMAX standards

For more WiMAX standards in the IEEE 802.16 series, please contact the IEEE [24].

Standard	Titel	Frequency range
IEEE Std 802.16	Air Interface for Broadband Wireless Access Systems	Defines wireless networks in major cities in frequency ranges above 10 GHz.
IEEE Std 802.16.1	WirelessMAN-Advanced Air Inter-face for Broadband Wireless Access Systems	
IEEE Std 802.16.1a	WirelessMAN-Advanced Air Inter-face for Broadband Wireless Access Systems - Amendment 2: Higher Reliability Networks	Defines wireless networks in major cities in frequency ranges between 2 and 11 GHz.
IEEE Std 802.16.1b	WirelessMAN-Advanced Air Inter-face for Broadband Wireless Access Systems - Amendment 1: Enhancements to Support Machine-to-Machine Applications	Defines wireless networks in major cities in frequency ranges between 10 and 60 GHz.

Reference is made to [21] for more details about the specifications and standards featured in this section, which takes a more detailed look at all networks and point-to-point connections with relevance for AAL systems.

The components of an AAL system can also be networked using other topologies such as wired or wireless star or mesh.

4.1.3 Electrical installation buses/building automation field buses

The German market has three essentially competing “families“ of house bus systems (for building automation field buses) which can all be used to connect building automation sensors and actuators to AAL systems. Reference is made to [21] for further details, which takes a more extensive look at all three house bus systems (KNX, BacNet and LON):

- **DIN EN ISO 16484** Building automation and control systems (BACS)
- **DIN EN 50090 (VDE 0829)**) Home and building electronic systems (HBES).

Some field buses may support several alternative physical bus media (e.g. twisted pair, power-line, wireless networks). The bus systems also define profiles for different device types that can be uniformly actuated via the house bus.

The wireless networks ZigBee, EnOcean, Z-Wave and IP500® named in the preceding section also address the house bus system market and can therefore be viewed as competitors to the house buses named here.

The use of building automation and control systems for implementing AAL systems is discussed in the VDI guideline VDI 3812 sheet 1 Building automation technologies - Requirements for electrical installations and building automation and control systems. The use of AAL systems depends on barrier-free electrical installation pursuant to VDI/VDE 6008 part 3.

The large number of house bus systems competing on the market which are often not suitable or not cost-effective for installation or replacement of an AAL system in an existing home leads to the recommendation to forge ahead with the development of a standardized abstract interface for connecting the AAL systems to various house bus systems (see section 5.6.2).

4.1.4 Field buses with other application

Another field bus type is the CAN bus (Controller Area Network). This is an asynchronous serial bus system belonging to the family of field buses. The CAN bus was developed in 1983 for networking control units in cars. CAN is standardized on the international level as ISO 11898 and defines layer 1 (physical layer) and 2 (data backup layer) in the ISO/OSI reference model.

- **DIN EN 50325-1** Industrial communications subsystem based on ISO 11898 (CAN) for controller-device interfaces – Part 1: General requirements

4.1.5 Application protocols for sensors and actuators

Together with the house bus systems named above, which each define a communication protocol through to the application level for the supported device categories (layer 7 of the OSI reference model pursuant to ISO/IEC 7894-1), separate standards apply to the sensors and actuators of other branches of industry, which are listed below. Reference is again made to [21] for details:

- **ISO/IEEE 11073 Health informatics –** Personal health device communication. This standards family defines an application protocol for networking vital sign sensor devices using USB and Bluetooth among others. But in practice, up to now the individual device vendors use their own proprietary interfaces. Some parts of this standards series are also available as DIN EN ISO 11073.
- **DIN EN 50523** Household appliances interworking. This is a standard for networking electrical household appliances (“white goods”) and was initially developed as an industrial standard “CECED Home Appliances Interoperating Network (CHAIN) Application Interworking Specification”. Powerline communication pursuant to DIN EN 50065-1 (“European Home Systems”, part of the KNX specification) or ANSI/EIA/CEA 709.2-A (LON) is used as communications medium.
- Furthermore, there are several standardized TCP/IP based protocols that can be used to control networked devices in the AAL context: the Session Initiation Protocol (SIP) pursuant to RFC 3261, Universal Plug and Play (UPnP) [UDA08] and the Devices Profile for Web Services (DPWS) [25].
- It is also worth mentioning new de-facto standards such as BlueRobin, primarily serving medical sensors. Most applications are unidirectional, although there is an increasing trend towards bidirectional (complex) application [26].

4.2 Usability and accessibility

For an information system to be used, it must be easy and straightforward to operate. This property is defined as “usability“ in English (and translated as “Benutzerfreundlichkeit” or “Gebrauchstauglichkeit” in German). The following standards indicate the concrete meaning of usability. It is defined among others in DIN EN ISO 9241-11.

A system is said to be usable when it works at least to the satisfaction of the users. To this end, it must permit users to fulfil their tasks and objectives in an effective, efficient and assenting manner. However, the usability of a user interface is always highly dependent on the context. The weighting of various aspects of usability depends on the context, so that it is appropriate to stipulate specifications for different contexts.

The following additional standards have been published among others related to usability:

- **DIN EN ISO 14915** Software ergonomics for multimedia user interfaces. This standard focuses on media and navigation. It names the principles such as target orientation, understandability, structure and user motivation;
- **DIN EN ISO 11064** Ergonomic design of control centres. This standard stipulates environment-related requirements for control centres, regulating their design processes and working conditions;
- **DIN EN 60601-1-6 (VDE 0750-1-6)** Medical electrical equipment - Part 1-6: General requirements for basic safety and essential performance - Collateral standard: Usability. As in DIN EN ISO 14915, this standard describes the requirements made of the process. Here again the focus is on usability, while basic safety is another essential aspect and prerequisite for CE marking
- **DIN EN 62366 (VDE 0750)** Medical devices - Application of usability engineering to medical devices. This standard stipulates the obligation for compliant process and risk management and is prerequisite for CE marking;
- **ISO/IEC Guide 71** Guidelines for standards developers to address the needs of older persons and persons with disabilities. This document provides guidelines for designing accessible systems for older persons and persons with special needs. It helps to improve the general situation of the elderly and the disabled. The intention is not just to inform developers but to support authors of specifications in this field. ISO/IEC Guide 71 is available as European guide CEN/CENELEC GUIDE 7.
- **ISO/IEC TR 29138-1** Information technology – Accessibility considerations for people with disabilities – Part 1: User needs summary
- **ISO/TR 22411** Ergonomics data and guidelines for the application of ISO/IEC Guide 71 to products and services to address the needs of older persons and persons with disabilities is an important collateral document containing instructions for using the ISO/IEC Guide 71. The Technical Report contains ergonomic data and knowledge about human capabilities in the sensory, physical and cognitive sphere and when suffering from allergies.

- **DIN EN 301549:2013-05** Accessibility requirements suitable for public procurement of ICT products and services in Europe

Together with these standards and specifications dealing with barrier-free access, there are also guidelines for web content accessibility (WCAG) 2.0. The Web Content Accessibility Guidelines were developed by the W3C in cooperation with affected users and groups with the aim of issuing recommendations for barrier-free access to web content. Consideration is given to the blind and partially sighted, the deaf and those whose hearing is deteriorated, those with learning difficulties, cognitive restrictions, restricted mobility, speech impediments, photosensitivity and combinations of these disabilities.

The WCAG 2.0 success criteria were not defined as technology-specific statements. Instructions for fulfilling the success criteria for certain technologies are stipulated in other documents, together with general information for interpreting the success criteria [27].

Here reference is made to the activities of the UPnP Friendly Devices Working Committee which develops guidelines (so-called Device Control Protocols or DCP) to give UPnP components a user-friendly identification.

Mandate M 376 European Accessibility Requirements for Public Procurement of Products and Services in the ICT Domain issued by the European Commission stipulates that the three European standardization organizations CEN, CENELEC and ETSI should harmonize procedures for public procurement of products and services in the field of information and communication technologies in Europe and to make such procedures easier.

The following Technical Reports were compiled in the framework of Mandate 376 [28]:

- **Draft TR 01550** Documents relevant to EN 301549 “accessibility requirements for public procurement of ICT products and services in Europe, listing the standards and specifications used for the requirements and tests in the EN 301550.
- **Draft TR 101551** Guidelines on the use of accessibility award criteria for publicly procured ICT products and services in Europe , providing guidelines for contract award criteria.
- **Draft TR** Guidance for the application of conformity assessment to accessibility requirements for public procurement of ICT products and services in Europe.”
- The Mandate has also produced a European standard which is to be published in early 2014 on obtaining approval from the national standardization organizations:
- **EN 301549** Accessibility requirements suitable for public procurement of ICT products and services in Europe

4.2.1 Personalizing user interfaces

The user interface is the point where man meets machine. The user interface is allocated to neither man nor machine. The basic know-how required for a user-friendly interface design is influenced and shaped by ergonomics and personalization. Similarly, basic aspects in the development of user interfaces are analyzed and developed to simplify, adapt and personalize adaptable future interfaces for different user groups in future.

- The standard series ISO/IEC 24751 IInformation technology – Individualized adaptability and accessibility in e-learning, education and training is geared to the needs of people and users with learning disabilities in this context. It defines framework conditions to describe on the one hand the needs and preferences of the learners and on the other hand to provide a corresponding description of the digital learning aids. The individual needs and preferences of the learners can be reconciled with the corresponding user interface, tools and digital learning aids.
- **ETSI ES 202 746 V1.1.1:2010-02** Human Factors (HF); Personalization and User Profile Management; User Profile Preferences and Information. This specification lists a broad vocabulary for user profile data and covers a wide range of user and device functions.

4.3 Basic technologies

4.3.1 Service-Oriented Architecture (SOA) and web services

The phrase service oriented architecture (SOA) was used for the first time in 1996 by the market research company Gartner [32]. SOA has various definitions, with the one stipulated by the OASIS Group in 2006 being frequently used:

„... A paradigm for organizing and utilizing distributed capabilities that may be under the control of different ownership domains. It provides a uniform means to offer, discover, interact with and use capabilities to produce desired effects consistent with measurable preconditions and expectations“ [33].

Service oriented architectures try to create a flexible, reusable software architecture for cutting development costs and avoiding new developments.
SOA defines function units, so-called services, whose interfaces can be described by corresponding technologies, e.g. for web services this is the Web Service Description Language (WSDL).
Although the SOA paradigm is not tied to underlying technologies, XML is usually used to describe the services. Interface description should be independent of the protocol being used and the underlying functionality in order to permit loose coupling of services and thus great flexibility.

The Technical Report Information technology – Distributed Application Platforms and Services (DAPS) - General Technical Principles of Service Oriented Architecture has been published and provides a concrete definition for SOA. Service Oriented Architecture is designed as an „architectural style that supports service orientation and is a paradigm for building business solutions."

Furthermore, service orientation is defined as an „approach to designing systems in terms of services and service-based development" [34].
In addition, work is currently in progress on the standard series ISO/IEC 18384 „Information technology – Reference Architecture for Service Oriented Architecture (SOA)".

4.3.2 Devices Profile for Web Services (DPWS)

The Devices Profile for Web Services (DPWS) is a specification originally developed by Microsoft that addresses the use of web services in combination with devices that have only minimum resources. The WS web service specification was extended to permit reciprocal communication between such usually embedded systems so that they can connect up to and disconnect from each other autonomously when added or removed. DPWS also uses parts of web services to describe services with corresponding meta data and to exchange events between these services.

To define the simplest, most flexible possible interface, both DPWS and web services use the internet as transfer medium.

4.3.3 Machine-to-Machine (M2M)

Machine-to-Machine is an ETSI specification that stands for the automated exchange of information between machines. M2M plays an increasingly important role in the internet of things.
The basic technology can be adapted in the AAL environment so that it is also increasingly significant for the AAL environment. It describes generally useful M2M functions such as security, data transmission, boot strapping and an application programming interface for services.
The API permits communication between individual M2M components (such as sensors and actuators), M2M gateways and service platforms. Systems and machines should exchange data in a completely automated process without human interaction. M2M abstracts from the basic LAN and WAN technology. ETSI-M2M was developed on the basis of requirements from a

number of use-case documents. Relevant examples in the AAL context are eHealth (TR 102 732) and Connected Consumer (TR 102 857).

Moreover, the one M2M Partnership Project was set up in July 2012 to win over organizations involved in M2M-related business domains and areas, such as telematics and smart transport, the healthcare sector, utility companies, industrial automation, smart houses etc. so that they play an active part in the M2M work. The aim of oneM2M is to develop technical specifications to visualize the need for a joint M2M service layer that can be easily embedded in various hardware and software. These specifications are necessary so that the large number of devices in the field can be globally linked with M2M application servers. ETSI-M2M will focus primarily on EU topics.

The notable specifications of ETSI-M2M [35] are:

- ETSI TS 102 689: M2M service requirements
- ETSI TS 102 690: M2M functional architecture
- ETSI TS 102 921: M2M mla, dla and mld interfaces (draft)

4.4 Middleware/services/runtime platform

Sections 4.4.1 to 4.4.3 below present specifications for the runtime environment which are basically suitable for implementing AAL gateways, although none of these systems is tailored specifically to the requirements of the AAL sector. For example, there is no cross-vendor interface (or a respective service) for remote maintenance of AAL systems (see section 5.6.1).
Nor do any of the named runtime environments permit flexible connection to different house bus systems (see section 4.1.3) without using possibly proprietary add-ons. At the moment, specific software execution environments for AAL services are being developed in projects based on the runtime environment rules described below.

4.4.1 Multimedia Home Platform (MHP)

The MHP was created in the framework of the European DVB project for transfer and display of interactive contents using the digital television infrastructure. The first version was adopted in 2000. The current version MHP v1.2 has been available since March 2010.

The services offered through MHP can be put into two categories. Firstly, there are services that do not need a return channel (extended teletext, complex electronic program guide (EPG) etc.), and secondly, services needing a return channel (e.g. home-shopping or voting).

In technical terms, MHP applications can be combined with every broadcasting method specified by the DVG (DVB-S, DVB-T and DVB-C). The MHP specification for the return channel applies regardless of the respective transport technology, so that it is possible to use e.g. DSL, ISDN, an analogue mode or the digital cable network. Applications can be programmed in DVB-J as Java program against the MHP API or in DVB+HTML, which is far more complex and therefore rarely used by many mobile terminals. Developers can also revert to existing commercial middleware implementations.

4.4.2 Mobile Information Device Profile (MIDP)

The MIDP specifies a profile of the Java Micro Edition (Java ME) [57]. It is based on the Connected Limited Device Configuration (CLDC) which provides a quantity of system-related functions. MIDP was developed within the Java community process and has been available since April 2001. The current version is MIDP 3.0 and has been available since December 2009.

MIDP uses a sandbox model with certain security against malware. The hardware on which an MIDP application (a so-called MIDlet) runs must fulfil certain requirements in terms of display resolution and main memory, and have a (virtual) sound card and an internet link. The profile provides functionality for user interfaces, connectivity, visualization of multimedia contents, remote distribution and component updating.

4.4.3 OSGi

The OSGi Alliance has developed a frequently used middleware specification. Corresponding middleware frameworks are called OSGi platform and are available for purchase and also as open source freeware. But in some cases there are considerable differences in quality and in the demands made of system resources. The OSGi Alliance founded in 1999 is a nonprofit cooperation consisting of developers and technology innovators with a focus on specifying a hardware-independent platform for service management and distribution. A Java virtual machine (JVM) is prerequisite for hardware-independent operation of an OSGi platform. Some projects are based on OSGi. The EU SOPRANO project for the AAL sector uses OSGi together with ontologies intended for communication [30], [31]. SOPRANO also founded the AAL Open Association (AALOA) in conjunction with the EU projects MonAmI, OASIS, OsAmI-commons, PERSONA, SOPRANO, universAAL and WASP. However, OSGi defines a service Java-based run-time environment that was not developed primarily for the AAL environment, even though it is frequently used in this setting.

4.4.4 Universal Plug and Play (UPnP)

The Universal Plug and Play (UPnP) protocol was originally developed by Microsoft, like DPWS. On-going development of the specification is meanwhile carried out by the UPnP forum which also certifies UPnP-compliant devices.

UPnP is independent of the underlying transmission technology, as long as IP communication is used. This means that e.g. Ethernet, Bluetooth, WLAN or Firewire can be used for transmission.

Like DPWS, UPnP devices can connect up to and disconnect from each other autonomously, and react to events. Service descriptions available at so-called control points (e.g. on a hand-held device or at a residential gateway) permit device control by means of corresponding SOAP messages. This possibility can be used for example to open ports at a router or to search and reproduce a media collection at network attached storage (NAS). When using UPnP, there are special profiles for building automation which is why UPnP is frequently used in this setting.

The UPnP+ initiative focuses on complete integration of IPv6, supporting the integration of contents and services from the cloud, improved support for low-power and mobile devices, grouping or pairing of similar devices and services, as well as bridging to non-UPnP network such as ZigBee, Z-Wave and Bluetooth. This bridging and implementation of UPnP+ refers to a broad field of applications, including health and fitness, energy management and building services.

4.4.5 Broadband Forum TR-069

TR-069 is a protocol that provides among others the auto-configuration of mobile terminals to simplify mobile terminal access to the network. TR-069 lets mobile terminals contact auto-configuration servers (ACS) for automatic configuration. TR-069 is the prime interfacing relay for mobile terminals on the DSL broadband market. The technical specifications (TR-069) are published by the Broadband Forum.

Together with the core standard TR-069 which deals primarily with DSL routers, there are also several secondary standards for the special functionalities of other mobile terminals behind the NAT/firewall of the presumably present DSL router with corresponding access to the router. In addition, the Broadband Forum aims to extend the standard to fiberglass and other broadband connection technologies. The Broadband Forum also defines other relevant data models and protocol extensions that can be used for example for remote maintenance and configuration of telephones and for module management.

4.4.6 IHE BPPC (Basic Patient Privacy Consent)

The IHE Profile Basic Patient Privacy Consent (BPPC) offers a mechanism for documenting patient consent(s) together with a procedure for content consumers to assert consents according to their use. This profile supplements XDS by describing a procedure by which an XDS affinity domain can develop and describe several privacy guidelines.

4.4.7 Universal Remote Console (URC)

URC is standardized on the international level by the standards series ISO/IEC 24752.
The specification defines a framework that can be used as basis by existing technologies and specifications such as UPnP or Java-Jini; together with pure remote control functionalities it also offers the possibility of stipulating alternative user interfaces. This gives various users different user interfaces for the same device. The heart of the URC framework is the user interface socket, a standardized interface for users.

But although the URC structure is based on existing protocols for device control, it works independently of such protocols. URC is therefore not restricted to one device protocol but can integrate any device protocols and network infrastructures, creating the necessary transparency for the end user.

A further section of the standard series ISO/IEC 24752 on mapping web services is to be published by the end of 2013, bringing the standard series to altogether 6 parts. Application is to be simplified and mapping to web services facilitated.

4.4.8 EEBus

EEBus is a system that provides interfaces between the device infrastructure in the building and energy utilities. The EEBus describes the use of existing communication specifications, standards and products so that applications and services can be exchanged between energy utilities and households in order to boost energy efficiency. This is one result of the E-Energy funding program launched by the Federal Ministry for Economic Affairs and Technology (BMWi) and the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety and was developed accordingly in the framework of the Smart Watts sub-project.

Initial situation
In future, energy systems will be far more dependent on volatile sources such as wind or solar energy and organized on a more local basis than today. This development demands more intensive exchange of information between everyone involved in the process.

Private households in particular will play a more active role than hitherto. All scenarios presume that information about energy management can be shared between all participants.

Structure of the EEBus

The EEBus is the interface between inhouse communication and data exchange with the energy utility. At the moment it is not yet clear which form of access to the house will become established for exchanging energy management functions. Discussions include among others smart meters just for power or for several areas (multi utility communication controller or just multi utility controller, abbreviated to MUC), so-called energy management gateways or pure DSL router solutions. The EEBUs is therefore not assigned to any certain type of device.

The core or network layer has two tasks. Firstly, this is where the abstract XML data coming from the energy utility is translated into the specific situation in the household and vice versa, in other words, electricity price signals are translated into the protocols of the household devices. The second task is for inhouse data exchange so that devices can communicate over and beyond protocol boundaries, by stating the weighting that they contribute to a reduction in power.

Standardization

In May 2010, the DKE published an E-Energy/Smart Grid Standardization Roadmap. The EEBus uses specifications and extends them where necessary. By using existing specifications and in view of the current focus on communication paths between power line, radio and Ethernet, the EEBus complies with the recommendations given in the roadmap for load management and building automation.

The named extensions are being produced in consultation with the respective standardization organizations. They will become official parts of these specifications at the next possible opportunity and integrated in the corresponding standards. The DKE Inhouse Automation working group will be accompanying the further standardization process for the EEBus.

Despite the fact that the EEBus e.V. initiative and its members are currently focusing on smart grids and energy policy issues, the same architecture and thought processes can be used to extend the range of applications and include other domains such as AAL.

4.4.9 Home Gateway Initiative (HGI)

The Home Gateway Initiative is an industrial consortium dealing with the specification of profiles for home gateways. This goes beyond the technical link to an internet provider to include supporting application scenarios, also in the AAL environment.

HGI produces its own specifications on various topics, such as the requirements for linking up home gateways. Other details can be found on the HIG website [65].

4.5 Data exchange on the health sector

As soon as installation and intended purpose fall within the scope of the Medical Devices Law, additional specific standards have to be heeded for exchanging data on the health sector and for complying with corresponding regulations.

4.5.1 Document-centered specifications

Document-centered specifications address the permanent persistence and exchange of personal medical data. The focus is on medical document formats that warrant machine access to the document contents stored in structured fashion and annotated at least in part by machine-readable codes. The presented document formats permit full machine readability and thus processability without this being a constraint.

4.5.1.1 Continuity of Care Record (CCR)

The Continuity of Care Record (CCR) was developed in the USA with support from various medical societies and associations under the auspices of the ASTM (American Society for Testing and Materials). The CCR consists of a cohesive record of a patient's key medical information. It is a kind of snap-shot of the patient's key medical data and can be simply extracted from an electronic health or patient file (e.g. after a doctor's appointment). The CCR defines sections containing structured data, e.g. about diagnoses or allergies, or information about the health insurance. The CCR is stored in the eXtensible Markup Language (XML) and is machine readable [22].

4.5.1.2 Clinical Document Architecture (CDA)

The Clinical Document Architecture [36] is an XML-based specification developed by the Health Level 7 (HL7) committee for exchange and storage of personal medical content. A CDA document corresponds to a clinical document, such as a doctor's or discharge letter. The following attributes distinguish the CDA format from an HL7 version 3 message:

- Persistency: the CDA retains its document character before and after being sent between institutions.
- Responsibility: a CDA document is managed by a person or organization.
- Authentication: a CDA document can be authenticated within the framework of the valid statutory provisions.
- Entirety of the document: authentication applies to the entire document.
- Context: all information contained in a CDA document is coherent with regard to a context.
- Readable for persons.

CDA documents can be divided into various levels regarding the degree of structuring and the machine-readable coding of their content. A CDA document on the minimum level 1 has a structured header with details about the document author, the context in which it originates, the patient it refers to and an "unstructured" body, whose contents can be read by persons (e.g. displayed on a web browser). On levels 2 and 3, the semantics of the body (section headings, contents of the individual sections) are described by code systems and data types to permit machine evaluation.

4.5.1.3 Continuity of Care Document (CCD)

The Continuity of Care Document (CCD) bridges the gap between the contents of the CCR and the data structure of the CDA. The information contained in the CCR is depicted as CDA templates in CDA-compliant documents. In concrete terms, the CDA header is adopted and the CDA body is compiled with the information contained in the CCR footer [37]. The application-centered integration profiles XPHR and PHMR described in sections 4.5.1.4 and 4.5.1.5 also comprise a CDA-based summary of health-related information and therefore differ only slightly from the CCD.

4.5.1.4 IHE Exchange of Personal Health Record Content (XPHR)

XPHR describes a document format for the exchange of medical data between a personal electronic health file (EGA) controlled by the owner and an electronic patient file (EPA) kept by doctors for example about their individual patients. XPHR is based on CCD (and therefore defines a CDA template) and can be combined with the XD* profiles named in section 4.5.2.4. IHE speaks of “binding” [38] to describe the process of bringing together an XD* profile together with the contents specified in XPHR, for the purposes of transport. The content information specified in XPHR is based on CDA. The CDA header information can be used by the binding specified by IHE to automatically derive part of the meta data necessary for XDS. More information can be found in [21] and [8].

4.5.1.5 CONTINUA Personal Healthcare Monitoring Report (PHMR)

The Personal Healthcare Monitoring Report (PHMR) was developed jointly by the Continua Health Alliance and HL7 so that in the framework of homecare monitoring, both the collected sensor data and the key medical information from the home environment of the users can be stored and communicated to players in the health system. The PHMR is based on CDA documents and keeps as close as possible to the CCD [21], [40]. CONTINUA uses the IHE integration profile XDR for transmitting PHMR documents between doctor and user (see section 4.5.2.5) [41].

4.5.1.6 DICOM Structured Reporting

Since April 2000, DICOM Structured Reporting (SR) is an official extension of the DICOM specification (Digital Imaging and Communications in Medicine). While DICOM essentially regulates the storage and communication of medical imaging data, DICOM-SR standardizes the storage of measurement data and findings. DICOM-SR documents are transmitted with the DICOM network protocol. This uses the same DICOM header featured with DICOM images, together with details of the patient, the breakdown of the documents into studies and series, and data of the generating system, with the addition of the actually structured content in the form of a document tree [42],[43],[44]. DICOM-SR has become established primarily in application domains using DICOM images (e.g. radiology, cardiology), because the IT infrastructure already established for imaging can also be used to create, transmit and store additional measurement data and findings. On the other hand, the use of DICOM has not been usual procedure hitherto in the GP sector and in the AAL context.

4.5.1.7 DIN EN ISO 13606 Electronic Health Record Communication (EHRcom)

EHRcom is being developed by the “Medicine IT” Technical Committee of the European Committee for Standardization (CEN/TC 251) in cooperation with ISO/TC 215 to facilitate semantically interoperable exchange between electronic health files (EGAs). EHRcom uses a two-level information model:

- The first level is a relatively simple reference model for defining data types that are to remain stable over a long period of time. The individual medical concepts such as blood pressure, for example, are derived from the reference model using rules.
- These so-called archetypes form the second level of the information model. They are described by a formal language and collected and managed together in central repositories. Similar to the message protocol, part of this specification is still being developed. More information can be found in [21] and [42].

4.5.1.8 xDT as additional data exchange format

xDT is a group of data exchange formats used in the German healthcare sector by general practitioners. It is an important data interface in outpatient healthcare in Germany. It was produced on behalf of the National Association of Statutory Health Insurance Physicians (KV). The formats have a shared, text-oriented syntax where each field is written as a line in the file, together with a shared field directory. An XML-based structure is practically indispensable for web-based data transfer, cross-sector exchange of medical information and automated use of the recorded data.

4.5.2 Communication-centered specifications

Various communication protocols have become established for networking IT systems on the health sector. They are used for inner-sector or cross-sector communication to exchange domain-specific information and data.

4.5.2.1 HL7

Health Level Seven (HL7) [45] stands for a group of specifications for the exchange of data between organizations on the health sector. There are two different versions for the HL7 message standard - version 2 and version 3 - with inherent differences in their characteristics.

4.5.2.2 HL7 Version 2

The HL7 version 2 specification serves for system integration in hospitals. It is used for example for intra-sectoral communication of patient data and findings by means of HL7 messages. Events trigger HL7 version 2 messages containing information about the event together with the corresponding data. Events according to HL7 are for example being admitted to or discharged from hospital. The generated message format is based on ASCII text which is broken down by standardized field separators. Information units in a HL7 message are divided into segments. A message segment consists of fields whose data type describes which character strings are permitted. Within an HL7 message, segments are therefore specified information units with a clear name and structure. The patient information segment (PID) for example represents a patient's personal data. Messages can be allocated to various groups fulfilling certain tasks. But there is no underlining concept to categorize the messages on the basis of a reference model. The drawback here consists on the freedom of interpretation of the precise semantics of a message. This leads to many "dialects" which in turn are detrimental to interoperability. On the other hand, HL7 v2 addresses scenarios limited to internal communication within one institution. Cross-institution data exchange is therefore not covered by HL7 v2, in contrast to the version 3 described below. More literature on HL7 version 2 can be found in [46].

4.5.2.3 HL7 Version 3

HL7 version 3 [47] is based on a reference information model (RIM) with a backbone consisting of four basic classes and two auxiliary classes representing the relations between the basic classes. These six classes are used to derive about 70 classes representing the RIM. In this way, it is possible to model different players, roles and actions defining the inter- and also intra-sectoral range, permitting consistent modelling of the communication processes on the whole health sector. Furthermore, all messages that can be derived from the RIM are coded in XML, permitting flexible transmission and message validation.

Concrete scenario modelling by the RIM leads to a refined model (refined message information model) with data types to define all attributes and where the concrete message can be depicted in XML. Although the HL7 version 3 specification has still not been completely implemented in Germany yet, the Clinical Document Architecture (CDA) document specification is available in release 2 with structure derived completely from the RIM. The way in which the version 2 specification has become established within the hospitals and the structural concept of version 3 advocate the use of HL7 version 3 for inter-sectoral communication.

4.5.2.4 DIN EN ISO 11073

DIN EN ISO 11073 defines a standards series to warrant the exchange of medical sensor signals and vital signs from patient-related devices (originally intended for intensive medicine). The aim is to bring about interoperability between heterogeneous systems and devices. To this specific purpose, DIN EN ISO 11073 defines standardized interfaces for medical devices and also specifies the communication link so that devices can be connected up by even technically inexperienced personnel. DIN EN ISO 11073 also covers the recognition and configuration of devices for data exchange purposes. This application has given the standards series relevance to the home care sector. More literature can be found in [21].

4.5.2.5 IHE XD* (XDS/XDR/XDM)

The family of XD* integration profiles of the IHE organization (Integrating the Healthcare Enterprise) summarizes specifications for the exchange of medical knowledge:

- Cross-Enterprise Document Sharing (XDS),
- Cross-Enterprise Media Interchange (XDM),
- Cross-Enterprise Document Reliable Interchange (XDR).

XDS and its related specifications were originally created by the IHE to facilitate access to remote patient files. However, the XD* profiles are content-agnostic and do not access in any way the document they encapsulate as a pure payload, so that in principle, all kinds of documents can be managed and distributed. The XD* profiles define corresponding meta data with a structure similar to CDA. The individual profiles differ as follows:

XDS describes the exchange of medical documents via remote document servers with a central document registry (“pull”). Documents stored on the central register or in archives are described by meta data based on binding index data, an agreed IT infrastructure and a global patient identification. The meta data standardized in this way offer various institutions in the health sector a transparent, remote solution for accessing documents. With XDS, actual communication takes place via web services, usually encrypted and protected by certificate-based authentication of the participating IT systems. More information can be found in [48].

XDM describes a file and folder structure for exchanging documents using different kinds of data carrier such as CD-R or USB sticks.

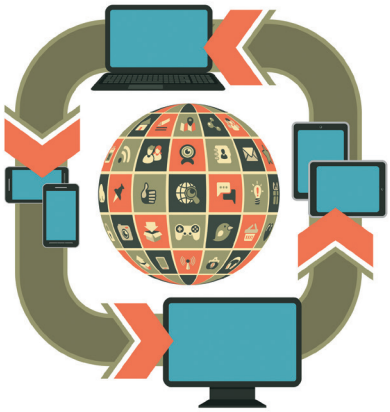
XDR uses the same technical basis as XDS to define a reliable message system for sending documents of a patient directly (“peer to peer) to the recipient (“push”, instead of putting them on a central infrastructure for exchange purposes. [42].]. As with XDS, communication is based on secure web services.

4.5.2.6 XACML (eXtensible Access Control Markup Language)

XACML is an XML scheme that standardizes the visualization and processing of authorization policies. It is used to set up rules which, when evaluated, control the access of subjects to the resources of a system. Version 2.0 was ratified by the OASIS standardization organization in February 2005, followed by version 3.0 in August 2010. It also serves as process model, describing how to evaluate authorization enquiries according to the defined rules.

As a published standard, one of the objectives of XACML is to promote shared terminology and interoperability between the uses and implementations of various providers.

4.6 Specifications and standards for operator models



4.6.1 Quality management systems in general

4.6.1.1 DIN EN ISO 9000 (et seq.)

The standards series DIN EN ISO 9000 et seq. stipulates principles for quality management measures. DIN EN ISO 9000 mainly contains definitions and descriptions for the general understanding of the whole standards series DIN EN ISO 9000 et seq. This structure is then “fleshed out“ in standards DIN EN ISO 9001 and DIN EN ISO 9004. Since the version DIN EN ISO 9000:2000, the standards are also process-oriented, which facilitates application on the services sector (as in the AAL context). Standard DIN EN ISO 9001:2000 describes the requirements made of a quality management system in the eight principles of quality management (customer focus, management, human involvement, process-oriented approach, system-oriented management, continuous improvement, relevant decision-making approach, supplier relations for mutual benefit), while standard DIN EN ISO 9004 describes the guidelines for implementing the principles of total quality management in an organization. DIN EN ISO 9004 is implemented in the EFQM model.

4.6.1.2 DIN EN ISO 14001

DIN EN ISO 14001 can apply to all kinds of organizations. It contains requirements for existing environmental management systems with instructions for their implementation. This includes identifying and controlling effects on the environment, continuous improvement of environmental compatibility and a systematic approach to implementing environmental objectives. DIN EN ISO 14001 describes the principles for setting up, introducing, monitoring, advancing and certifying environmental management systems. DIN EN ISO 14000 et seq. is acknowledged all over the world. Organizations can be certified to ISO 14001 by an accredited approval authority (e.g. VDE Institute).

4.6.1.3 EMAS

EMAS (Eco Management and Audit Scheme) is a seal of approval of the European Union for companies fulfilling the EMAS Regulation. It is based on ISO 14001, is valid throughout the EU and is deemed to be the most demanding system for sustainable environmental management. Interested organizations draw up environmental declarations describing the environmental management system, KPIs and objectives of the environmental policy, and have these audited by an independent, state supervised environmental expert. The environmental declaration has to be updated every year. Furthermore, EMAS organizations undertake to proceed with continuous improvement of the environmental performance over and beyond statutory requirements.

4.6.1.4 VDE-AR-E 2757-1

The application guide VDE-AR-E 2757-1 “Ambient Assisted Living (AAL) – Terms and definitions“ was published in May 2013 and specifies terms and definitions for ambient assisted living.

4.6.1.5 VDE-AR-E 2757-2

The application guide VDE-AR-E 2757-2 “Staying at home service – Requirements for suppliers of combined services“ applies to setting up networked technical systems for supporting self-determined living at home in the patient’s own four walls using telemedicine components and service offers for the home environment.

4.6.1.6 VDE-AR-E 2757-3

The application guide VDE-AR-E 2757-3 “Staying at home service – Criteria for the selection and installation of AAL components“ stipulates a guideline for the selection of devices and specific aspects to be heeded during respective installation.

4.6.1.7 VDE-AR-E 2757-4

The application guide VDE-AR-E 2757-4 “Staying at home service – Quality criteria for providers, services and products of Ambient Assisted Living (AAL)” describes suitable criteria for enhancing the quality of AAL products and services together with the related service concepts.
It provides guidance regarding the quality criteria that are significant in the special environment of AAL. Here the focus is on the quality criteria for safety and efficiency together with usability and ergonomic aspects.

4.6.1.8 VDE-AR-E 2757-5

The application guide VDE-AR-E-2757-5 “Ambient Assisted Living (AAL) – Requirements for the qualification of persons working in the field of AAL” is under preparation and is expected to be published by mid 2014.
It specifies the content-related requirements for the qualification of those working on the AAL sector. These include the expert (AAL guide) who advises people about the possibilities of ambient assistance on the everyday level and helps them to select the right AAL services, systems and equipment, the technically skilled person entrusted with technical installation of the chosen AAL solution and the carer (assistant) who is in constant contact with the AAL user and provides assistance on all fronts. The working areas of these individuals are described with reference to how they fit into the German qualification framework, with an indication of their tasks and responsibilities. Finally, the specific qualification measures are specified in detail.

4.6.1.9 VDE-AR-E 2757-10

The application guide VDE-AR-E-2757-10 “Ambient Assisted Living (AAL) – Requirements for mobile terminals for use in the field of AAL“ is under preparation and is expected to be published in summer 2014.

Specifications are needed for mobile terminals to permit location-independent access to everyday ambient assistance solutions so that buildings can be equipped accordingly. At the same time, specifications such as the VDE application guides support uniform, interoperable, profitable and safe development of such mobile terminals. Allocating quality classes to requirement categories also helps to establish the highest possible provider and user acceptance.

The VDE application guide VDE-AR-E-2757-10 provides a detailed list of requirements in terms of design, operation, communication and power supply as well as stipulating the different user groups for every device class. It also contains the corresponding requirements made of manufacturers and integrators.

4.6.1.10 VDE-AR-E 2757-100

The application guide VDE-AR-E 2757-100 “Ambient Assisted Living (AAL) – Guideline for the development of AAL products“ is under preparation and is expected to be published in January 2014.
This VDE application guide specifies the procedure for developing products that are designed specially as ambient assistance systems or that should be designed right from the start so that they can be used by as many people as possible without modification, using a „design for all“ approach. After clarifying whether the intended development has to heed special regulations, the products are classified according to intended purpose and specific task. Finally the general approach for pre-development of AAL products is described in detail with graphic visualization. The aim is to ensure that early consideration is given to such important aspects as final user involvement together with the compatibility of user requirements and product attributes, interoperability and usability.

4.6.1.11 VDE-AR-E 2757-6-1

The application guide VDE-AR-E 2757-6-1 “Ambient Assisted Living (AAL) – Representation of Integration Profiles - System Planning Overview“ is under preparation and is expected to be published in early 2014.
This VDE application guide looks at the method for describing integration profiles in the AAL sector. It deals with the abstract view of AAL integration profiles and provides a method for universal, cross-domain and cross-job description of AAL solutions on a function-oriented level abstracted from technical implementation.

4.6.1.12 DIN SPEC 91280

DIN SPEC 91280 specifies the classification of AAL services for the home environment in various application areas.

4.6.1.13 DIN SPEC 77002

DIN SPEC 77002 stipulates the requirements for AAL services referring to the home or immediate living environment and in the context of an AAL system. It describes requirements for these services, regardless of the content of the AAL service and should enable the service provider to provide a top quality AAL service.

4.6.1.14 DIN SPEC 91300-1

DIN SPEC 91300 aims above all to foster the setting up of viable business models in the content of ambient assistance services. Part 1 of the DIN SPEC 91300 series describes the organization units required for a business model.

4.6.1.15 DIN SPEC 91300-2

Part 2 of the DIN SPEC 91300 series stipulates the workflow organization belonging to the business model, visualizing it as an extended event-drive process chain.

4.6.1.16 DIN SPEC 91300-3

Part 3 of the DIN SPEC 91300 series describes interfaces between technical systems, between people and technical systems and between people.

4.6.1.17 DIN SPEC 91300-4

Part 4 of the DIN SPEC 91300 series describes various financing models. A financing model for ambient assistance services consists of a cost model, proceeds model, billing/price model and a payment model.

4.6.2 Quality management on the health sector

Assuring the quality of service provision in the German health sector is stipulated in Sections 135 et seq. German Social Code V. Pursuant to Section 135a German Social Code V, all panel doctors, medical supply centres, licensed hospitals, providers of prevention services or rehabilitation measures together with all institutions with a care mandate pursuant to Section 111 a (maternal convalescence facilities and similar) are obliged,

- to take part in cross-institution quality assurance measures with the special aim of improving the quality of results, and
- to introduce an internal quality management system with on-going further development.

It is up to the affected organizations themselves to choose which method is applied; the following possibilities exist:

- Certification to DIN EN ISO 9001;
- Certification to DIN EN ISO 9004;
- Certification to KTQ® (Cooperation for Transparency und Quality in Healthcare): catalogue of criteria (patient orientation, staff orientation, safety, IT; leadership, quality management) with recertification every three years, presumes that a quality management system is in place and confirms the suitability of the system for KTQ certification;
- Certification to pCC (proCum Cert): for facilities run by the churches, adds a system of Christian values to the KTQ catalogue of criteria;
- Certification Geriatric Seal of Approval: drawn up by the BAG Geriatrie (Federal Consortium of Clinical Geriatric Facilities), DGG (German Geriatric Society) and DGGG (German Gerontology and Geriatric Society), presumes that a quality system is in place;
- Certification to QEP® (Quality and Development in Practices): quality management system offered by the Associations of Statutory Health Insurance Physicians, consisting of a catalogue of quality targets (patient care, patient rights and patient safety, staff and advanced training, practice management and organization, quality development), a manual (QM practice manual) and familiarization seminars for practice staff;
- Certification to EPA (European Practice Assessment): EPA exists for five medical disciplines (general practice, dental medicine, paediatrics youth medicine, specialist, medical care centre) and is geared to indicators and encompasses on-line benchmarking;
- Certification to VDE-AR-M 3756-1: Quality management for telemonitoring in medical applications. This VDE application guide is based on ISO 9000 and ISO 9001 and stipulates the quality requirements for telemedical services.

4.6.3 Standards for quality and risk management of medical devices

4.6.3.1 DIN EN ISO 13485

DIN EN ISO 13485 describes specific quality management pursuant to DIN EN ISO 9000 et seq. for vendors of medical devices. Basically the standard consists of chapters on the quality management system, management responsibility, the management of resources and product implementation together with measurement, analysis and improvement. The standard addresses the implementation of critical processes such as re-call and averting contamination.

4.6.3.2 DIN EN ISO 14971

DIN EN ISO 14971 describes risk management for medical devices and encompasses risk analysis, appraisal and control by means of measures management, risk re-appraisal after the implementation of measures and market monitoring after delivery of the medical device. The risk management results are an integral part of the technical documentation for a medical device.

4.6.3.3 VDE-AR-M 3756-1

VDE-AR-M 3756-1 “Quality management for telemonitoring in medical applications“ stipulates the requirements made of a quality management system for an organization. The primary aim of this application guide is to interpret the main requirements for the organization resulting from DIN EN ISO 9000:2000 and DIN EN ISO 9001:2008 together with DIN EN ISO 13485:2001 with regard to the applications for a telemonitoring system. In this way it is possible to fulfil the requirements made by the patients/persons on the one hand and the basic statutory requirements for medical devices including related services on the other hand.

Where AAL components are also medical devices, they should fulfil the harmonized standards on medical devices pursuant to EU Directive 93/42/EEC. This means giving due consideration not just to the standards DIN EN ISO 13485 and DIN EN ISO 14971 mentioned above but also the whole standards series DIN EN IEC 60601 (VDE 0750). At present the scope is currently being expanded in IEC/TC 62 to include processing AAL standards.

4.6.4 Other relevant standards and certifications

There are other standards and certifications with possible relevance in the AAL context, including issues such as data protection (privacy) and facility management.

4.6.4.1 Data protection specifications

A high level of information security is indispensable for a successful AAL environment. Security-relevant issues must be defined already in the preliminary stages of development, taking care to ensure a security architecture in the AAL environment. Large quantities of sensitive data are processed by AAL systems and associated services. Examples include vital signs, details about social contacts, domestic activities and illness data. Some areas are already covered by directives or legislation, including e.g. patient-related data processing. To start with, these include the EU Directives (Directive 95/46/EC of the European Parliament and of the Council of 24 October 1995 on the protection of individuals with regard to the processing of personal data and on the free movement of such data) and national implementation by the German government (Federal Data Protection Law in the amended version as of 14 January 2003 (Federal Gazette I p. 66), last amended by article 1 of the law dated 14 August 2009 (Federal Gazette I p. 2814) and the state data protection legislation. Other relevant documents include the criminal code and social law in the relevant social codes [A. Meier. Der rechtliche Schutz patientenbezogener Daten. VVW Karlsruhe, 2003] together with the Basic Law. Other laws such as the telecommunications law may have to be heeded for data going over and beyond health data.

It is also important to clarify the difference between data protection and data security. Clear data security concepts must be defined already during the development phase. Furthermore, data production must be integrated in all the manufacturer and service provider services.

Various ISO/IEC working groups (as in JTC1/SC27/WG5) are currently working on international specifications for data protection [50]. In concrete terms, these are:

- **ISO/IEC 29100** Information technology – Security techniques – Privacy framework (definition of privacy requirements in processing personal data in the information systems of all countries),
- I**SO/IEC 29101** Privacy reference architecture (best practices for consistent technical implementation of privacy principles) and
- **ISO/IEC 24760-1** IInformation technology – Security techniques – A framework for identity management – Part 1: Terminology and concepts, (framework for secure, reliable privacy conformity management of identity information) [51].
- The use and disclosure of security and risk management standards and specifications is also important. The ISO/IEC 27000 standards series is relevant in this context. In addition,

the BSI standards on IT baseline protection (BSI IT Grundschutz) are of particular significance. Attention is required in particular to ensure that data in the AAL system are made anonymous.

- All relevant privacy objectives are covered by the six objectives of the Conference of State Commissioners for the Protection of Data and Freedom of Information.
  These objectives are:
  – availability, – integrity,
  – confidentiality, – transparency,
  – non-linkability, – intervenability.

Privacy implementation always entails a combination of technical and organizational measures.

4.6.4.2 Quality management facility management

The GEFMA (German Facility Management Association) offers the GEFMA FM-Excellence, which adds facility management aspects to DIN EN ISO 9001.

4.7 Building Information Modelling

4.7.1 Building Information Modeling/Industry Foundation Classes (BIM/IFC)

“Building Information Modelling“ describes a method for software-optimized planning, implementation and management of buildings. The building is constructed as a 3D model with a link to building data. This 3D building model is used to develop all floor plans, views, perspectives, sections, quantities and mass documentation. All drawings and evaluations are updated whenever the model is changed.

The ISO/TC 59/SC 13 “Organization of information about construction works“ is currently working on the issue of BIM. The results generated hitherto include the standards ISO 29481-1:2010 Building information modelling – Information delivery manual – Part 1: Methodology and format and ISO 29481-2:2012 Building information models – Information delivery manual – Part 2: Interaction framework.

BIM data are transferred using the IFC format (Industry Foundation Classes). All parts and components currently existing in the building are defined in this format as objects, and retrieved/interpreted as such in programs supporting this specification. At the moment, Vectorworks is certified for IFC2x3 [52].

The ISO/TC 184/SC 4 “Industrial data” of ISO/TC 184 “Automation systems and integration” also works on issues of special relevance to IFC. One recent project entailed working on ISO/CD 16739:2013 Industry Foundation Classes for AEC/FM data sharing, which corresponds to IFC4.

4.7.2 CityGML

CityGML is a collection of tools for 3D visualization of buildings and objects in the urban environment. It defines relationships between the key objects in cities and regions in terms of geometric, topological and semantic aspects, including hierarchies between topical classes, aggregations and relationships between objects and the external distinguishing characteristics. It gives local authorities autonomous control over the use and distribution of their city models and opens up new application areas for different target groups.

CityGML is an open data model based on XML for data storage and transfer of 3D city models. It is implemented as an application scheme for the Geography Markup Language 3 (GML3), which is used as international specification for geodata exchange by the Open Geospatial Consortium (OGC) and the ISO/TC 211 “Geographic information/Geomatics” [53], [54].

4.8 Use case-centered integration profiles

With regard to achieving interoperability of all components in an AAL system from the user’s point of view, the standards and specifications presented in sections 4.1, 4.2 and 4.3 are necessary for the integration of system components, services, middleware and usage interfaces (where the aim is for an open, expansible system architecture), but not sufficient on their own. Most interface specifications offer a large number of options so that incompatibility can be caused as a result of a specific selection of the supporting options for two standard-compliant components. In addition, assistance systems require a combination of several specifications, together with a depiction of labels and values of the various specifications in each other.

The transfer of vital sign parameters can be taken as an example here. On transferring the vital sign parameters from a measuring device per ISO/IEEE 11073 to a gateway for subsequent summary forwarding as PHMR document to an operator service at a telemedicine centre, it is necessary to define exactly how to convert the vital sign parameters of the ISO/IEEE 11073 format into the PHMR document format.

Use case-centered integration profiles are one approach to solving such problems. A typical use case identifies all players (participating systems and system components) and all transactions (necessary interfaces between these systems and system components). Suitable interface specifications are selected for every interface, reducing the respective options by additional restrictions so as to obtain plug-and-play interoperability for the corresponding use case. This is frequently possible because the options of an interface specification take account of the need to support many different use cases. On the other hand, as far as one single use case is concerned, it is frequently possible to stipulate with relative accuracy which options are required and which are not. In the end, necessary rules are defined for depicting the values and labels of the various participating interface specifications on each other.

The combination of use cases, players and transactions with the corresponding specializations of the selected interface specifications and the depiction rules result in an integration profile, which can be referred to as meta specification (depiction for the application of specifications in a certain use case).

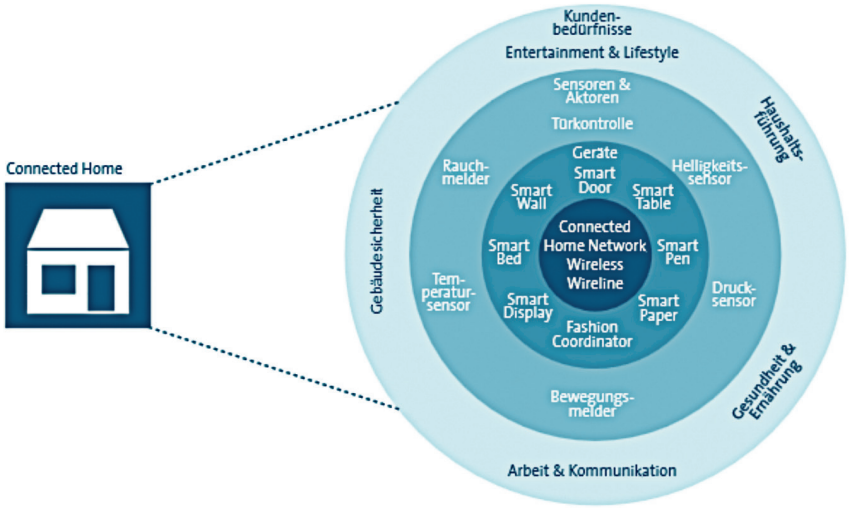
4.9 AAL and Smart Home

The AAL environment needs a certain infrastructure which in many cases overlaps with the smart home infrastructure (see Figure 3). It is therefore necessary to reach agreements between these two domains. Suitable PR measures can help to elaborate synergetic effects with smart meters and smart home applications.

Ambient assistance technology refers in general to systems that make it easier for users to perform tasks and carry out movements which can only be done to a limited extent if at all without using these technical devices. Sensors installed in the house can record activities and request necessary support. The connection between ambient assistance technology and smart home applications consists for example in linking sensors to entertainment applications (with gesture control, for example) for controlling the home environment and various devices when there is need for assistance and the user has limited mobility. However, the AAL environment is not limited to the home environment but also includes the user‘s environment when the user is mobile and leaves the home.

G. Demiris et al. refers to the smart home as „residences equipped with technology that enhances safety of patients at home and monitors their health conditions“ (p.88) [55].

Figure 3 – Smart Home devices as per Glasberg & Feldner, 2008 [39]



4.10 Overview of use cases and their definitions

4.10.1 Domain

In this document, a domain is a group of applications such as safety, health or entertainment or similar in order to group together diverse smart functions. Certain individual functions, such as roller blind control, can be used in several domains. Roller blind control belongs to both the safety domain and the energy domain. New technological developments have recently also revealed cross-domain aspects; electromobility for example belongs to the energy domain and the mobility domain. These aspects are featured in individual domains to keep things simple. However, situations arise in standardization where it is necessary for the standards in all domains to be fulfilled as marginal condition for these applications and their desired interoperability [56].

4.10.2 User Story

A user story usually consists of a text describing what is generally a cross-domain smart home application as seen by the user.

4.10.3 Use Case Templates

A uniform use case template is to be produced for analyzing use cases. The details entered in the template make it easier to proceed with individual use case clusters and analyses. The use case templates approach is already being put to the test on an international level and is to be transferred to the national level.

4.10.4 Use Case

A set of necessary use cases can be derived from the user stories. Use cases provide a detailed workflow description as seen by the players and components in the smart home architecture.

Several use cases are generally included in implementing a use story. A mapping table illustrates the relationship between user stories and use cases (mapping user stories - use cases).

Use cases can be combined with a descriptive text and illustrated as a sequence of individual steps in a sequence diagram.

Several similar use cases are allocated to one or several domains. One such specific task (user story) for example is the air conditioning of a house or room. Air conditioning then needs the following use cases, for example [56]:

- temperature measurement e.g. per room (provided by sensors);
- possible evaluation of other sensors (windows open, presence detection);
- climate control (provided by temperature controller or ventilation controller);
- heating/ventilation control (provided by one or several actuators).

4.10.5 Functions

A function is an action performed to fulfil a certain purpose or objective which can be specified or described; the means needed to achieve the objective are not featured in any greater detail here.

4.11 Definitions VDE-AR-E 2757-1

Specific terms are defined to ensure a uniform understanding of the expressions used in the AAL environment. This promotes a uniform understanding in the AAL environment and safeguards communication between the experts of different areas. In addition, this permits transparent conduct vis-à-vis the customer and simplifies an understanding of AAL products. Corresponding discussions are based on the application guide VDE-AR-E 2757-1:2013-05 Ambient Assisted Living (AAL) – Terms and definitions.

5 RECOMMENDATIONS FOR AAL

The following section presents the recommendations of the German Standardization Roadmap AAL. These result from the status of AAL in Germany as presented above in the fields of research, development and standardization. Reference is also made at this point to the work of the DKE working group STD 1811.0.12 AAL Interoperability in cooperation with the consortium of the Roadmap AAL Interoperability project funded by the BMBF (Federal Ministry of Education and Research), which published a book in June 2013 entitled „Leitfaden interoperable Assistenzsysteme – vom Szenario zur Anforderung as part 2 in the series entitled „Interoperabilität von AAL-Systemkomponenten“ [57].

5.1 Internationality

Demographic change is not a special national trait but a trend that is apparent in all industrial countries. The market for AAL products can therefore be expected to be a European or even global market rather than a national one limited to a country’s borders. It therefore makes sense to establish international or at least European standards for AAL so as not to impede the introduction of AAL systems on the European Single Market (and beyond) through incompatible national standards. Consequently, the whole AAL environment has to be illuminated in all aspects on a comprehensive scale and with the widest possible international approach.

This requires German representation and involvement of AAL experts in the corresponding European and international standardization bodies and organizations to ensure that the development of specifications and standards relevant to AAL takes due account of both the AAL-specific aspects and also the specific national requirements, such as those practiced by the CONTINUA Health Alliance through the VDE initiative in micro-medicine.

In the longer term, it would also seem appropriate to take a coordinated European approach to AAL interoperability similar to that taken in the field of eHealth interoperability with the EU mandate M403-2007. This would entail giving the relevant standardization bodies (including CEN, CENELEC, ETSI) a mandate obliging them to develop a long-term joint strategy for AAL-specific standardization. Furthermore, an international steering unit is needed for the AAL environment on the ISO side, corresponding to the IEC/ SG 5 AAL.

4 eHealth-INTEROP Report in response to the eHealth Interoperability Standards Mandate (EU Mandate/403-2007), http://www.ehealth-interop.eu [61]

Task	Responsiblity	Timeframe
Promoting AAL on the international standardization level	International standardization organizations with support from the national standardization organizations (DIN/DKE)	Activities are currently in progress, a system-oriented committee is to be set up by the IEC by the end of 2014
International steering unit on the ISO side as an equivalent to the IEC/SG 5e	Initiated by DIN	Promptly, by the end of 2014 at the latest

5.2 European coordination body

It is deemed appropriate to set up an „umbrella“ for qualification in the AAL field, which could pool various activities and qualification measures, as well as ascertaining demands and requirements.

Task	Responsiblity	Timeframe
Setting up an „umbrella“ for parallel qualification in the AAL field within Europe	Support by national standardization organizations	Promptly

5.3 Central databases

Together with a concrete product database, a central database is to be set up that lists all AAL specialists.

Task	Responsiblity	Timeframe
Product database	DKE AAL working group STD_1811.0.3 „AAL products“	Promptly

5.4 Definition of those working in the AAL field

Clear distinctions should be made between all those working in the AAL field together with their task areas.

Task	Responsiblity	Timeframe
Distrinctions between those working in the AAL field	DKE AAL working group STD_1811.0.10 „Quality criteria“	By mid 2014

5.5 Further training

Players in the AAL field face heterogeneous, widespread tasks which make it necessary to extend their skills. Further training possibilities and additional qualifications should be defined and made available.

Task	Responsiblity	Timeframe
Progress should be made in further training possibilities and additional qualifications	DKE AA working group STD_1811.0.10 „Quality criteria“	By mid 2014

5.6 Interoperability

Complete interoperability in the AAL environment needs an interoperable technical basis to safeguard the modularity of all components. AAL integration profiles can be used to facilitate technical interoperability (see section 4.8).

The Digital Living Network Alliance (DLNA) pursues a similar approach in the multimedia/ connect home sector. A comparable organization does not exist for AAL up to now. There is a need to clarify whether a new organization should be set up for these purposes, or whether one of the existing organizations (IHE, Continua, DLNA) is willing to expand its sphere to include Ambient Assisted Living. This also concurs with the recommendations of the “AALIANCE Report on Standardization Requirements for AAL” [58], which says that:

“Steps have to be taken to […] develop and promote a reference model that gives guidance to product and service developers, develop and promote design guidelines and a certification process for AAL products and services. This should be based on identification, selection and

5 http://www.dlna.org/home

promotion of existing standards, and gaps should be identified and filled. […] It is questionable whether across the full AAL domain the time is right for a coordinated approach like the CONTINUA alliance; maybe the scope of the CONTINUA alliance could be gradually extended for next versions of their specification. Creating a common vision and stimulation towards such a vision is highly advisable."

Continua enables communication with healthcare IT via HL7. It would be appropriate to adopt similar structures for the AAL system.

5.6.1 Remote maintenance of AAL systems and components

As AAL systems are designed primarily for older users and therefore often for users with limited technical skills, it is recommendable to create possibilities for troubleshooting and remote maintenance of a system.

The standards collection offers definitions for defining and classifying a fault, which take the same approach although the wording may vary. According to DIN 55350-31:1985-12 „Concepts of quality management and statistics", a fault is the „non-fulfilment of stipulated requirements on the part of an attribute". This implies that functionality does not generally have to be impaired and leads to the following classification for an occurring fault:

- Critical nonconformance – results in dangerous, critical situations
- Major nonconformance – possible failure or reduction in functionality
- Minor nonconformance – only slightly impaired functionality

Other literature on fault management and operational reliability can be found in [57].
Similar definitions are featured in the following standards and guidelines.

- DIN 66271:1995-06 und
- IEEE Standard 1044-1993 „Classification for Software Anomalies".

Operators of assistance systems also attribute great significance to possibilities for configuration, maintenance and troubleshooting of a system without the physical presence of a service engineer on the spot. The service provider must not only be able to proceed with remote maintenance and troubleshooting of the devices but should also increasingly have an overview of the complex AAL system of the individual user and be informed about the use of the individual components and communication protocols in the AAL system. The telecommunications sector has standardized protocols such as the CPE WAN Management Protocol (CWMP, also called TR-069) and OMA Device Management that can be used for remote maintenance of devices such as DSL routers or mobile phones, which permit an operator to proceed with automatic

remote configuration of devices and firmware updates as well as enabling certain service features; by contrast, corresponding standards are lacking for building automation and control systems and medical technology in general and also for the whole area of AAL.

At the moment, it is therefore not possible to proceed with uniform remote diagnosis, remote maintenance or remote configuration etc. of assistance systems featuring components of building automation and control systems or medical technology. As a result, there are considerable restrictions on the possibilities for remote support of such systems without the presence of a customer service engineer on site. What is needed here is a uniform protocol or administration tool for standardized polling of device information in order to permit remote maintenance of all components of a (possibly complex) AAL system. The Sensory Dataset Description Language is currently the only possibility in this respect to have seen corresponding research with on-going further development. The not yet standardized language permits the recording of sensory data for subsequent analysis of faulty system behaviour by system developers [59].

5.6.2 Abstract software interface for actuating building automation and control systems

As indicated in section 4.1.3, there is a whole series of competing approaches to building automation and control (BACnet, KNX, LON, ZigBee, Z-Wave and EnOcean). Consolidation of the market to just one field bus is not expected in the middle term. The developers of AAL systems therefore have to decide how to adapt the system to different field buses used in building automation and control systems, because as a rule, it will not be possible to replace the building automation and control system for the installation of an AAL system. When a lamp is turned on, or when a temperature sensor or movement sensor is monitored, in the end it is irrelevant for the software whether the data are transferred by cable or cordless connection and which communication protocol is used. However, when it comes to security of the data being transmitted and increased demands for transmission reliability, failsafe precautions or reaction times, it is possible that only certain protocols and a specific transport medium can be used. Only certain special systems used on the professional sector for anti-burglary protection and fire safety etc. can meet these requirements.

This entails developing an abstract standard interface for uniform actuation of the components in a building automation and control system, regardless of which field bus is involved. Possible technologies for this kind of interface include DPWS (see section 4.3.2) or Universal Plug and Play (see section 4.4.4). URC is another abstract interface for integrating devices with DPWS, UPnP, OSGi or other device protocols in one system. At the moment, work is in progress within the OSGi on an abstraction layer that specifies standard access to devices.

The EEBus should also be mentioned in this context. The EEBus is the interface between internal communication and data transfer with the utility company, with the intention of letting utility companies and households exchange applications and services in order to improve energy efficiency.

When an electrical installation bus is used with sensors, actuators and a control unit such as a server, most AAL applications (e.g. activity monitoring, device supervision) can be implemented by simple software additions.

5.6.3 Communication between AAL systems and health-sector IT systems

AAL systems permit continuous registration of medically relevant parameters and vital signs of medical sensors and actuators worn on the body in the home environment. For example, the relevant data can be made available to the attending doctor for the purposes of diagnosis and therapy, using a new wireless transmission technology known as the Body Area Network (BAN). At the same time, assistance systems also frequently contain local evaluation algorithms which for example can interrupt rehabilitation exercise when the vital signs exceed or fall below certain limit values. The definition of these limit values is customized to the individual patient. There is therefore frequently also a need for communication in the reverse direction, i.e. the provision of medical information from the hospital or doctor's practice, for configuring an assistance system.

Although the health sector has a whole series of pertinent standards for data transfer that could be used at least in part also for the AAL systems (see section 4.5), at the moment there is no flawless communication between the IT systems in hospitals and practices (i.e. hospital information systems, department information systems and practice management systems).

In addition, bidirectional electronic communication between assistance systems and health sector IT systems is implemented as proprietary solutions for specific projects.

While Germany is currently seeing efforts to standardize and implement electronic communication between doctors (e.g. electronic referral letters), electronic communication between health sector service providers and the home environment as health site is rare at present. Standardization (based for example on the work of the IHE and the Continua Health Alliance, see section 4.6) and implementation of this standard in health sector IT systems is a necessary prerequisite for establishing medical AAL systems successfully on the market.

5.6.4 Linking AAL systems to home emergency call services

Some AAL systems act as an alarm system with the task of detecting emergency situations, for example if the resident falls or has a heart attack, and then triggering an alarm. This necessitates linking the alarm system up to a home emergency call service. Up to now there has been no generally accepted procedure for reporting emergency calls through an alarm system. The common "communication protocols" are the telephone and alarm switches with proprietary link-up. The emergency phone numbers 110/112 even explicitly prohibit automated calls from machines. Given the increasingly widespread use of alarm systems that can send emergency calls, there is a need to define and implement a standardized process for linking up to emergency call services. The defined process should support reducing the possibility of redundant link-ups via several communication channels (e.g. landline and mobile phone) to facilitate high-availability alarm systems. Although home emergency call services will be a controversial issue in future, there are already initial ideas for implementing home emergency calls. For example, implementation can be based on reference to standard DIN EN 50134 that standardizes social alarm systems. In addition, the whole issue of home emergency call services should also consider the aspect of Emergency Call (eCall): this is an emergency call system for motor vehicles planned by the European Union. In an emergency, a device integrated in the vehicle automatically sends an emergency call to the standard European emergency call number 112. As well as transmitting a minimum dataset (MDS) to the central emergency service, a voice connection is also initiated. This kind of system can also provide fast help in an emergency in the AAL environment.

5.6.5 Languages for describing context information for AAL

While there are already many applicable standards for networking the components of AAL systems, there are no standards and specifications for representing knowledge in an AAL system. This is considerably detrimental to the semantic interoperability of different systems. Initial standardization activities are in progress for personalizing the language used to describe context information. This guideline should help to describe user preferences so that the personalization of one system can also be transferred to other systems. It would be particularly appropriate for different modules of an AAL system to have access to uniform context information:

- a layout drawing of the home showing the position of walls, doors, windows, furniture and the AAL sensors and actuators, together with the moving surface of windows and doors,
- information about the position and characteristics (e.g. range, field of vision) of every sensor,
- information for identifying the system users and their individual preferences,
- individual limit values for the normal range of monitored vital sign parameters and information about the user's loss of functions pursuant to ICF,
- contacts for human communication or the escalation chain for sending messages in an emergency.

The development of standards in this field is also recommended in the "AALIANCE Report on Standardization Requirements for AAL" [58]: "Steps have to be taken to […] move beyond the syntactical interoperability to the semantic and process levels. Stimulate research to develop standards for the AAL context in the semantic and process interoperability levels."

There are few software tools to help a planner in conceiving an AAL system with due consideration of the user's desires and needs together with the structural circumstances of the home. The only systems worth mentioning in this context are stated in section 4.5. This kind of planning system would necessitate standardization on the following topics, whereby the first standardization activities have already taken place (see section 4.5):

- Data format to describe the home (layout, walls, furniture, electrical installations, sensors, actuators).
- Data format to describe the hardware components of an AAL system: sensors, actuators, user interfaces, networks, gateways. This would let the vendors of corresponding components provide electronic product catalogues from which a planning tool can be imported and used, similar to KNX with the "Engineering Tool Software" (ETS) [60], for which many vendors provide electronic product catalogues.
- Data format to describe AAL services (basic services and application services, i.e. software modules) to let a planning system decide whether the systems can run on the planned or existing hardware, whether they are interoperable with the sensors and actuators, and which kind of assistance functions they provide.
- Data format to describe the individual user's loss of functions to let a planning system make suggestions to the planner for assistance systems and the corresponding sensors and actuators to cover the user's needs, particularly also with regard to extending an existing system to cope with further loss of functions suffered by the user.

5.6.6 Standard execution environment for AAL services

At the moment there are many approaches to the software execution environment for AAL services (including basic services, application services and provider services). The most important are presented in [21]. In the long term, it would be detrimental to the success of AAL if a separate gateway has to be installed for every assistance system, thus preventing the system from "growing" with the changing needs of the user. In addition, this prevents the use of previously installed sensors and actuators for several assistance systems and in the end is not very appropriate in terms of economic efficiency. Furthermore, all software infrastructures in different areas basically have to offer the same services. Examples include linking sensors and actuators, persistent data management, communication with the "outside world", interaction with the user via graphic user interfaces or multimodal interaction possibilities, as well as the management of context information etc.

In this context, it would be conceivable to create a uniform, standardized, cross-vendor execution environment for AAL services that provides the named software infrastructure and in which additional services can be installed, along the same lines as (or possibly building on the basis of) MHP, MIDP or OSGi. It will be crucially important to establish an "eco-system" of users and developers covering all aspects of this kind of standard execution environment in order to warrant on-going updating and further development, similar to the way this has been successful for the various Linux-based operating systems or for the App-Store for Apple's iPhone. Here consideration should be given to the work of the EU universAAL project (universal open platform and reference specification for AAL) and the AAL Open Association (AALOA).

5.6.7 Interfaces for external services

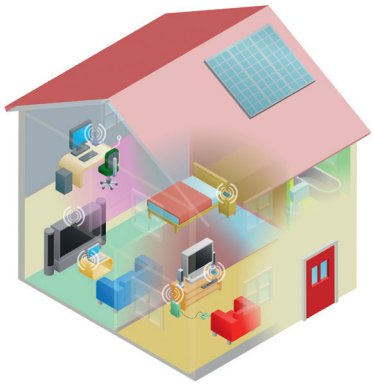
An AAL system needs to be connected to external services, for example to order products or domestic services on-line.

Many companies already offer the possibility of ordering products or services on-line, but this is usually via proprietary web portals. This demands on the one hand that the user learns how to cope with the structure and functioning of every new portal, while on the other hand impeding the implementation of user interfaces that are adapted to the user's specific loss of functions (such as restricted vision or motor skills). In this context, it would make sense to standardize pictograms and icons. When symbols are confusing, it becomes increasingly difficult and complex to work with interfaces. As in consumer electronics, where a triangle has become established for "play" or a square for "stop", uniform labels could help to improve recognition.
The use of pictograms should always be considered with due reference to the standards, such as DIN EN ISO 9241-210:2011 or ISO/IEC Guide 71.

Here the VDI guideline committee 6008 sheet 1.1 has started work with the aim of illustrating barrier-free versions of symbols and fonts for using products and systems in the field of technical building equipment.

In the business-to-business sector, the electronic depiction of logistics processes is already common practice, as with EDIFACT, ebXML or web services (see section 4.3.1). However, up to now the business-to-consumer sector does not have standardized interfaces (protocols) for obtaining product information and prices or sending orders by electronic means using corresponding web services.

Further standardization work should take account of the fact that the AAL aspect is being added to standards and specifications, contributing to a reduction in the development of completely new standards and specifications. This helps to enhance the understanding of the vendors on the one hand, while encouraging SMEs to get involved on the AAL sector on the other.



5.7 AAL in buildings and the living environment

In terms of housing management and electrical engineering, buildings and living environments still have a backlog in terms of AAL technology and installation. As well as establishing the starting point for implementing AAL in buildings and the living environment together with the requirements for technical implementation, there is also a need to improve and foster acceptance for innovative ambient assistance systems and new concepts.

Task	Responsiblity	Timeframe
Formulating requirements for technical implementation	DKE AAL working group STD_1811.0.4 „AAL in buildings and the living environment “	By mid 2014

5.8 Coordination between AAL and Smart Home

The infrastructure needed for AAL technology and systems is provided in many cases by smart home solutions so that there is a need to coordinate and reach agreement on work between AAL and smart home. Suitable PR measures and agreements can generate synergetic effects with smart meters and smart home applications. Coordination is also necessary between connected car technologies in the AAL field and smart home activities.

Task	Responsiblity	Timeframe
Agreement between the AAL and smart home domains	DKE AAL working group and DKE Smart Home working group, responsible for the standardization roadmap and use cases	Promptly

5.9 Further development of integration profiles and use case profiles for prototype application scenarios

Given the diversity of topical areas and standards relevant to AAL systems (see section 4), cross-vendor interoperability of systems and components will only be feasible if it is possible to identify "typical" AAL systems (or AAL applications) and to standardize the corresponding components, interfaces and data formats etc. Modelling such typical use scenarios corresponds exactly to the concept of use case-centered integration profiles used successfully in medical technology for several years to improve interoperability of complex heterogeneous IT systems (see section 4.6).

There is therefore an urgent recommendation to forge ahead with such process models and to develop integration profiles in cooperation with existing consortiums (such as Continua) at least on the European level.

Similarly, there is a need to align the various depiction possibilities and definitions used in the various domains such as AAL and smart home. This should cover definitions such as user story, use case templates, use case and functions.

Task	Responsiblity	Timeframe
Further development of integration profiles	DKE AAL working group STD_1811.0.12	By the end of 2014
Aligning definitions and depiction possibilities in the various domains	DKE working group STD_1811.0.12	By mid 2014

5.10 Information security for AAL

Information security for AAL systems must pay special attention to system availability as well as data protection and privacy, giving particular consideration to personal, sensitive data.

Care must be taken to ensure that information security is taken into account right at the start of AAL system architecture (security by design). The IT security architecture must consider conditions in the private living environment as well as possible future storage and processing of sensitive data in cloud solutions.

Furthermore, the architecture must serve to identify standardization gaps for punctual initiation of standardization needs in the DIN and DKE bodies.

Another important approach in this context consists of the work performed by the BSI (Federal Office for Information Security) in the field of smart metering. In 2010, the BSI was commissioned by the Federal Ministry for Economic Affairs and Technology to draw up a protection profile (PP) followed by a technical guideline (TR) for the smart meter gateway to safeguard a uniform technical security standard for all market players. Working on the basis of a threat analysis for secure, data protected operation, the protection profile stipulates the necessary minimum security requirements. As an added value service, AAL should be brought into the property via this security anchor. The approach must be examined accordingly giving due consideration to the BSI requirements in terms of the HAN (home area network) and WAN (wide area network) interface with normative documentation of the results.

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Task	Responsiblity	Timeframe
Safety and data protection in the AAL context: integrating safety concepts with involvement in designing a secure system architecture, collection and consolidation of user stories and use cases in the AAL environment for deriving roles and players. This is followed by threat analysis and by deriving security objectives to act as the basis for security functions (e.g. authentication) with subsequent risk analysis.	DKE AAL working group STD_1811.0.6	Promptly

6 LIST OF ABBREVIATIONS

Abbreviation/acronym	Meaning
AAL	Ambient Assisted Living
AALIANCE	European Ambient Assisted Living Innovation Alliance
AALOA	AAL Open Association
ACS	Auto Configuration Server
AK	Working group
ANSI	American National Standards Institute
API	Application programming interface
ARIB	Association of Radio Industries and Businesses
ASCII	American Standard Code for Information Interchange
ASTM	American Society for Testing and Materials
BACnet	Building Automation und Control Networks
BAG Geriatrie	Federal Consortium of Clinical Geriatric Facilities
BBF	Broadband Forum
BIM	Building Information Modeling Industry Foundation Classes
BMBF	Federal Ministry of Education and Research
BMWi	Federal Ministry of Economics and Technology
BPPC	Basic Patient Privacy Consent
BSI	Federal Office for Information Security
CAN	Controller Area Network
CCD	Continuity of Care Document
CCR	Continuity of Care Record
CD-R	Compact Disc - Recordable
CDA	Clinical Document Architecture
CECED	Conseil Européen de la Construction d'Appareils Domestiques
CEPT	European Conference of Postal and Telecommunications

Abbreviation/acronym	Meaning
CEN	European Committee for Standardization
CENELEC	European Committee for Electrotechnical Standardization
CHAIN	CECED Home Appliances Interoperating Network
CLDC	Connected Limited Device Configuration
CSMA/CD	Carrier Sense Multiple Access/Collision Detection
CWMP	CPE WAN Management Protocol (TR-069)
DECT	Digital Enhanced Cordless Telecommunications
DGG	German Geriatric Society
DGGG	German Gerontology and Geriatric Society
DICOM	Digital Imaging and Communications in Medicine
DIN	German Institute for Standardization
DKE	German Commission for Electrical, Electronic & Information Technologies
DLNA	Digital Living Network Alliance
DPWS	Devices Profile for Web Services
DSL	Digital Subscriber Line
DVB	Digital Video Broadcasting
DVB-C	Digital Video Broadcasting – Cable
DVB-J	Digital Video Broadcasting – Java
DVB-S	Digital Video Broadcasting – Satellite
DVB-T	Digital Video Broadcasting – Terrestrial
ebXML	Electronic Business using eXtensible Markup Language
EDGE	Enhanced Data Rates for GSM Evolution
EDIFACT	Electronic Data Interchange for Administration, Commerce and Transport
EEBus	E-Energy Bus

Abbreviation/acronym	Meaning
eCall	Emergency call
EFQM	European Foundation for Quality Management
EG	European Community
EGA	Electronic health file
EHRcom	Electronic Health Record Communication
EIA	Electronic Industries Alliance
EMAS	Eco Management and Audit Scheme
EMC	Electromagnetic compatibility
EN	European Standard
EPA	European Practice Assessment
EPG	Electronic program guide
ES	ETSI Standard
ESHG	Home and Building Electronic Systems
ETS	ETSI Technical Specification
ETSI	European Telecommunications Standards Institute
EU	European Union
GA	Building Automation and Control Systems
GEFMA	German Facility Management Association
GSM	Global System for Mobile Communications
HGI	Home Gateway Initiative
HL7	Health Level Seven
HSPA	High Speed Packet Access
ICF	International Classification of Functioning, Disability and Health
ICT	Information and Communication Technologies
IEC	International Electrotechnical Commission

Abbreviation/acronym	Meaning
IEEE	Institute of Electrical and Electronics Engineers
IETF	Internet Engineering Task Force
IFC	Industry Foundation Classes
IHE	Integrating the Healthcare Enterprise
ISDN	Integrated Services Digital Network
ISO	International Organization for Standardization
ITU	International Telecommunication Union
JTC	Joint Technical Committee
JVM	Java Virtual Machine
KNX	„Konnex“ (this is not an acronym)
KTQ	Cooperation for Transparency und Quality in Healthcare
LAN	Local Area Network
LK	Steering Group
LTE	Long Term Evolution
LON	Local Operating Network
LR-WPAN	Low-Rate Wireless Personal Area Network
M2M	Machine-to-Machine
MAC	Medium Access Control
MHP	Multimedia Home Platform
MIDP	Java Mobile Information Device Profile
MPBetreibV	Medical Device Operator Ordinance
MPG	Medical Devices Law
MPSV	Medical Devices Safety Plan Ordinance
MVZ	Medical Care Centre
NAS	Network Attached Storage

Abbreviation/acronym	Meaning
NFC	Near Field Communication
OASIS	Organization for the Advancement of Structured Information Standards
PHMR	Personal Healthcare Monitoring Report
PHY	Physical layer
PID	Patient Information Segment
QEP	Quality and Development in Practices
QM	Quality Management
RFC	Request for Comments
RFID	Radiofrequency Identification
RIM	Reference Information Model
RKI	Robert Koch Institute
SC	Subcommittee
SDDL	Sensory Dataset Description Language
SG	Strategic Group
SGB	German Social Code
SIP	Session Initiation Protocol
SMB	Standardization Management Board
SOA	Service Oriented Architecture
SOAP	Simple Object Access Protocol
TC	Technical Committee
TCP/IP	Transmission Control Protocol/Internet Protocol
TR	Technical Report
ULD	Independent State Data Protection Centre z
UMTS	Universal Mobile Telecommunications System

Abbreviation/acronym	Meaning
UPnP	Universal Plug and Play
URC	Universal Remote Console
USB	Universal Serial Bus
VDE	Association for Electrical, Electronic and Information Technologies
VDI	Association of German Engineers
WAN	Wide Area Network
WAVE	Wireless Access in Vehicular Environments
WG	Working Group
WHO	World Health Organization
WLAN	Wireless Local Area Network
WPAN	Wireless Personal Area Network
WS	Web Service Specification
WSDL	Web Services Description Language
XD*	(Generic term for XDS, XDR and XDM)
XDM	Cross-enterprise Document Media Interchange
XDR	Cross-enterprise Document Reliable Interchange
XDS	Cross-Enterprise Document Sharing
XML	Extensible Markup Language
XPHR	Exchange of Personal Health Record Content

ANNEX A

Standardization bodies

The following section lists the relevant national standardization bodies to start with:

DIN-Standards Committees

- NA 005 Building and Civil Engineering
- NA 022 DKE
- NA 023 Ergonomic
- NA 043 Information Technology and Applications
- NA 053 Rescue Services and Hospitals
- NA 060 Mechanical Engineering
- NA 063 Medicine

DKE-Committees and Working Groups

- DKE/K 111 Terminologies
- DKE/K 412 Communication cables (Cables, wires, waveguides, R.F. connectors, R.F. and microwave passive components and accessories
- DKE/K 461 Electricity metering
- DKE/K 511 Safety of household and similar electrical appliances
- DKE/K 513 Performance of household electrical appliances
- DKE/K 515 Automatic controls
- DKE/K 521 Lamps and related equipment
- DKE/K 711 Safety of electronic equipment within the fields of Audio/Video, Information Technology and Communication Technology
- DKE/K 712 Electrotechnical aspects of telecommunication equipment
- DKE/K 713 Melde- und Signaltechnik
- DKE/GK 715 Verbindung von Einrichtungen der Informationstechnik
- DKE/K 716 Elektrische Systemtechnik für Heim und Gebäude (ESHG)
- DKE/K 731 Funktechnik
- DKE/K 733 Sicherheit für Geräte der Unterhaltungselektronik und verwandte Systeme
- DKE/K 742 Audio-, Video- und Multimediasysteme, -geräte und -komponenten
- DKE/K 767 Elektromagnetische Verträglichkeit (EMV)
- DKE/K 810 Elektrische Geräte in medizinischer Anwendung
- DKE/K 811 Allgemeine Bestimmungen für elektrische Einrichtungen in medizinischer Anwendung
- DKE/K 812 Elektromedizinische Geräte
- DKE/K 821 Elektroakustik
- DKE/K STD_1811 Steering group AAL
- DKE/AK STD_1811.0.1 Basic principles and terminology
- DKE/AK STD_1811.0.2 Telemedicine
- DKE/AK STD_1811.0.3 Product development
- DKE/AK STD_1811.0.4 AAL in buildings and the living environment
- DKE/AK STD_1811.0.5 Mobile terminal devices/mobile applications for AAL
- DKE/AK STD_1811.0.6 Safety and data protection in the context of AAL
- DKE/AK STD_1811.0.7 Ambient assisted care
- DKE/AK STD_1811.0.8 Work environment
- DKE/AK STD_1811.0.9 Mobility
- DKE/AK STD_1811.0.10 Quality criteria
- DKE/AK STD_1811.0.11 Standardization roadmap AAL
- DKE/AK STD_1811.0.12 Interoperability

The following bodies exist on the European level:

CEN

- CEN/TC 215 Respiratory and Anaesthetic Equipment
- CEN/TC 251 Health Informatics
- CEN/TC 293 Assistive Products for Persons with Disability

CENELEC

- CLC/TC 13 Equipment for electrical energy measurement and load control
- CLC/TC 34Z Luminaires and associated equipment
- CLC/TC 46X Communication cables
- CLC/SR 59 Performance of household electrical appliances
- CLC/TC 59X Performance of household and similar electrical appliances
- CLC/TC 61 Safety of household and similar electrical appliances
- CLC/TC 62 Electrical equipment in medical practice
- CLC/SR 62 Electrical equipment in medical practice

- CLC/SR 62A Common aspects of electrical equipment used in medical practice
- CLC/SR 62D Electromedical equipment
- CLC/TC 72 Automatic controls for household use
- CLC/SR 76 Optical radiation safety and laser equipment
- CLC/TC 76 Optical radiation safety and laser equipment
- CLC/SR 77 Electromagnetic compatibility
- CLC/SR 100 Audio, video and multimedia systems and equipment
- CLC/TC 100X Focus Group AAL
- CLC/BTWG 105-2 Equipment for measuring electrical energy - composition and accuracy
- CLC/TC 108X Safety of electronic equipment within the fields of Audio/Video, Information Technology and Communication Technology
- CLC/TC 205 Home and Building Electronic Systems (HBES)
- CLC/TC 206 Consumer equipment for Entertainment and Information and related subsystems
- CLC/TC 210 EMC
- CLC/TC 215 Electrotechnical aspects of telecommunication equipment

ETSI

- ETSI/TC Digital Enhanced Cordless Telecommunications
- ETSI/EBU/CENELEC Joint Technical Committee 'Broadcast'
- ETSI/TC Machine to Machine Communication

Auf internationale Ebene sind schließlich folgende Gremien relevant:

ISO

- ISO/TC 59/SC 13 Organization of information about construction works
- ISO/TC 121 Anaesthetic and respiratory equipment
- ISO/TC 173 Assistive products for persons with disability
- ISO/TC 184 Automation systems and integration
- ISO/TC 215 Health informatics

ISO/IEC JTC

- ISO/IEC JTC 1/SWG 1 Accessibility
- ISO/IEC JTC 1/SC 2 Coded character sets
- ISO/IEC JTC 1/SC 6 Telecommunications and information exchange between systems
- ISO/IEC JTC 1/SC 7 Software and systems engineering
- ISO/IEC JTC 1/WG 7 Sensor networks
- ISO/IEC JTC 1/SC 17 Cards and personal identification
- ISO/IEC JTC 1/SC 23 Digitally Recorded Media for Information Interchange and Storage
- ISO/IEC JTC 1/SC 24 Computer graphics, image processing and environmental data representation
- ISO/IEC JTC 1/SC 25 Interconnection of information technology equipment
- ISO/IEC JTC 1/SC 27 IT Security techniques
- ISO/IEC JTC 1/SC 29 Coding of audio, picture, multimedia and hypermedia information
- ISO/IEC JTC 1/SC 31 Automatic identification and data capture techniques
- ISO/IEC JTC 1/SC 32 Data management and interchange
- ISO/IEC JTC 1/SC 34 Document description and processing languages
- ISO/IEC JTC 1/SC 35 User interfaces
- ISO/IEC JTC 1/SC 37 Biometrics
- ISO/IEC JTC 1/SC 38 Distributed application platforms and services

IEC

- IEC/CISPR International Special Committee on Radio Interference
- IEC/CISPR/SC H Limits for the protection of radio services
- IEC/TC 1 Terminology
- IEC/TC 13 Equipment for electrical energy measurement and load control
- IEC/TC 29 Electroacoustics
- IEC/TC 34 Lamps and related equipment

- IEC/TC 46 Cables, wires, waveguides, RF connectors, RF and microwave passive components and accessories
- IEC/TC 57 Power systems management and associated information exchange
- IEC/TC 59 Performance of household and similar electrical appliances
- IEC/TC 61 Safety of household and similar electrical appliances
- IEC/TC 62 Electrical equipment in medical practice
- IEC/SC 62A Common aspects of electrical equipment used in medical practice
- IEC/SC 62A Common aspects of electrical equipment used in medical practice
- IEC/SC 62D Electromedical equipment
- IEC/TC 64 Electrical installations and protection against electric shock
- IEC/TC 72 Automatic controls for household use
- EC/TC 76 Optical radiation safety and laser equipment
- IEC/TC 77 Electromagnetic compatibility
- IEC/TC 86 Fibre optics
- IEC/TC 100 Audio, video and multimedia systems and equipment
- IEC/TC 100 stage 0 project AAL
- IEC/TC 108 Safety of electronic equipment within the field of audio/video, information technology and communication technology
- IEEE Standards Association
- IEEE P1394.1 – High Performance Serial Bus Bridges Working Group
- IEEE 802 LAN/MAN Standards Committee
- Gremien für Industriestandards
- Neben den von den oben aufgeführten Gremien entwickelten Normen spielen auch Industriestandards im Anwendungsgebiet AAL eine größere Rolle. Im Folgenden sind daher hier die wichtigsten Gremien aufgeführt, die Spezifikationen mit Relevanz für AAL entwickeln:
- Continua Health Alliance
- Ecma International
- EnOcean Alliance
- Health Level 7
- Integrating the Healthcare Enterprise (IHE)
- Internet Engineering Task Force (IETF)
- Java Community Process
- OASIS
- Organization for the Advancement of Structured Information Standards (OASIS)
- OSGi Alliance
- UPnP-Forum
- ZigBee Alliance
- Z-Wave Alliance

ANNEX B

Benefit of AAL systems for various stakeholders

This annex gives examples describing the benefit of AAL systems for various stakeholders.

B.1 Chances offered by AAL technology

B.1.1 Benefits for the healthcare system/sector

- The financial burden on the health system will be reduced as affected persons can be looked after in their own home.
- Doctors‘ visits can be reduced thanks to a remote diagnosis by the doctor.

B.1.2 Advantages in terms of economic policy

- Jobs can be saved in the care sector while new jobs are created with the emergence of new work areas.
- New sales markets for the health sector, care industry, electrical industry, information and communications technology and power supply together with mobility providers.
- New fields of technology for the electrical trade.
- New business models can be established.

B.1.3 Added value for the citizen and final customer

- Enhanced conformity
- Assistance in caring for sick or aged relatives or for oneself.
- Independent living in one’s own four walls is safeguarded in the long term.
- Assistance is assured together with the social network.
- Fast contact to the doctor or contact person.
- Direct link to a service provider.

B.1.4 Chances for research and development

- Special requirements such as accessibility, easy handling and simple products give new impetus for research that can also generate improvements in other applications and fields of research.
- Product conformity in the overall system is a particular challenge.
- Research institutions working in Germany have the possibility of developing and taking up new topics in the field of AAL. These include in particular the synergetic effects between AAL and aspects of information and communication technology (ICT).
- Promoting developments in terms of interoperability and interconnectivity.
- Greater transfer of innovative ideas and results to standardizationv.

B.1.5 Chances for the electrical industry, SMEs, skilled crafts, test institutes

- New vocational areas are being created.
- Additional qualification and further training possibilities are being created.
- Affinity for technology is being supported.
- The use of innovative technology is promoted.
- New test areas are being opened up.
- New care concepts and the installation of new systems can generate new areas of occupation with a particular appeal for SMEs, the electrical trade, care institutions and the wholesale and retail sector in Germany.

B.1.6 Chances for the service provider

The introduction and acceptance of AAL systems will automatically generate new services and modify existing ones. It is not the job of the German Standardization Roadmap AAL to define new services in detail. However, a few examples will illustrate to what extent standardization and specification can make a supportive contribution to getting new services established.

- First of all, the technical systems have to be installed in the resident's environment. Given the fact that technical systems and components on the AAL sector have to fulfil special requirements, this will result in the emergence of an installation branch that specializes in the AAL environment.
- Classic services such as those that are currently used will have to cover a clearly much wider business sector. The technical aspect will play an increasingly significant role in addition to the social aspect.

B.2 Benefits of standardization for the AAL environment

B.2.1 Benefits for the healthcare system/sector

- The standardization activities can foster fast agreement and penetration of the AAL market, thus relieving the burden on the health system.
- Standardization creates a basis for understanding and facilitates the allocation of responsibilities in the complex AAL environment.

B.2.2 Advantages in terms of economic policy

- International standardization of system components helps to open up and safeguard markets, thus facilitating exports
- The German economy is safeguarded by clear, fast regulations and will play an increasingly influential role on the European and international market.

B.2.3 Benefit for the citizen and end customer

- Prompt standardization of the relevant requirements and interfaces ensures that AAL system components also reach the level of safety, availability, reliability and interoperability currently established in Germany.
- Standardization makes it easier for the end customer to take assured decisions, thus accelerating market penetration of the AAL sector.
- Top quality installation work is provided for the final customer in accordance with corresponding guidelines.

B.2.4 Benefit for research and development

- Standardization parallel to research work allows for active shaping and influencing of the standardization activities.
- Prompt standardization facilitates uniform action to reduce insular solutions in development activities.
- Standardization helps innovative developments to penetrate the market.

B.2.5 Benefit for the electrical industry, SMEs, skilled crafts, test institutes

- Defined criteria for product and test specifications create investment and legal certainty for the electrical industry and the electrical trade.
- For the vendors of AAL products, this results in new market and export chances on a national, European and global level.

B.2.6 Benefit for the service provider

- Standardization provides clearly structured regulations for the service provider.
- A standardized procedure for ascertaining the service provider's quality permits continuous service improvement.
- Standard communication interfaces lead to swift deployment and response times on the part of the service provider.

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