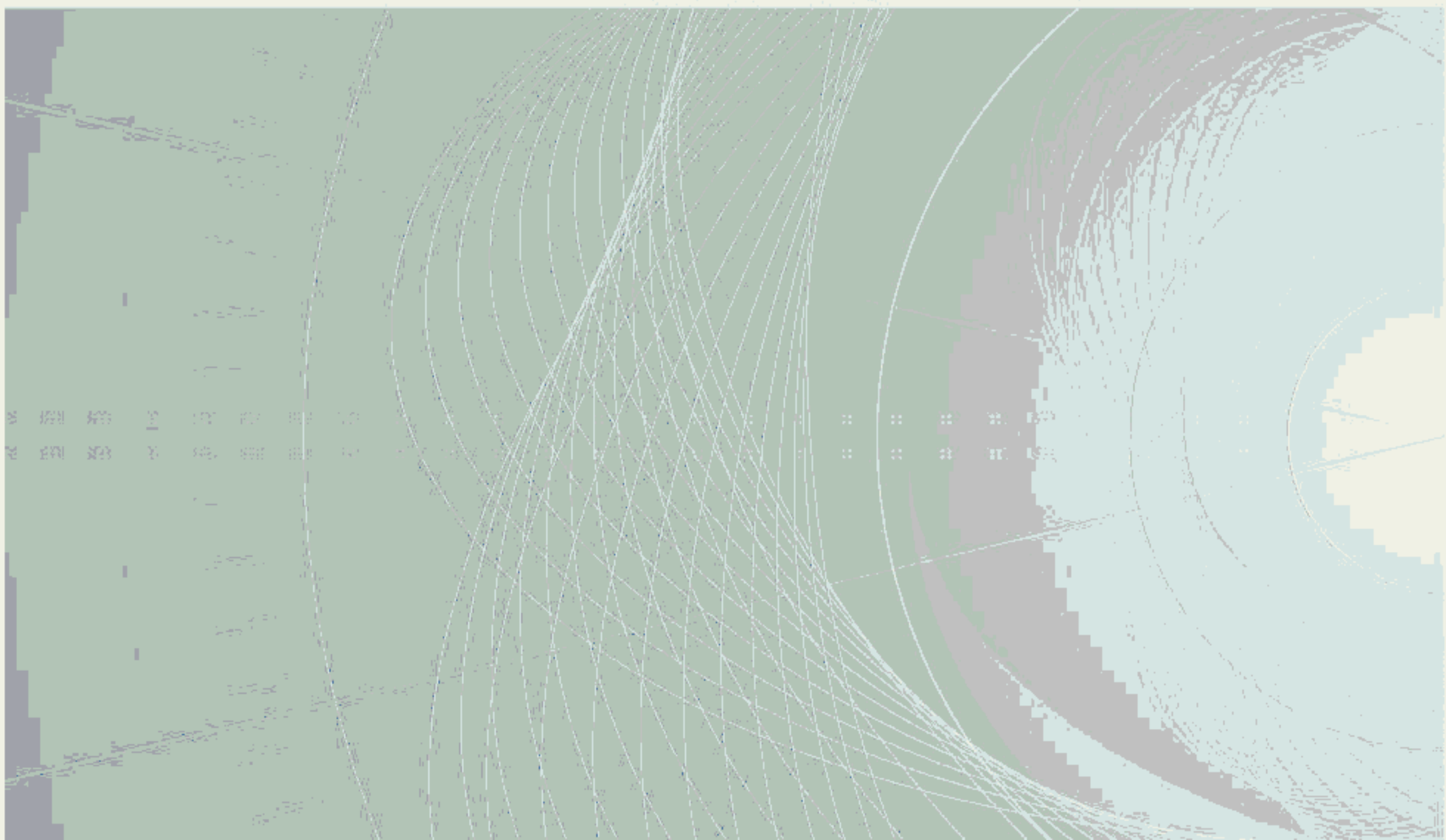
IEC 63240-1

Edition 1.0 2020-11

INTERNATIONAL STANDARD

Active assisted living (AAL) reference architecture and architecture model – Part 1: Reference architecture



IEC 63240-1:2020-11(en)

IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

About the IEC
The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications
The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigendum or an amendment might have been published.

IEC publications search - webstore.iec.ch/advsearchform
The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee,…). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished
Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

IEC Customer Service Centre - webstore.iec.ch/csc
If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: sales@iec.ch.

Electropedia - www.electropedia.org
The world's leading online dictionary on electrotechnology, containing more than 22 000 terminological entries in English and French, with equivalent terms in 16 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary
67 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

IEC 63240-1

Edition 1.0 2020-11

INTERNATIONAL STANDARD

Active assisted living (AAL) reference architecture and architecture model – Part 1: Reference architecture

INTERNATIONAL ELECTROTECHNICAL COMMISSION

ICS 11.020.99; 11.180

ISBN 978-2-8322-9080-4

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

_____

ACTIVE ASSISTED LIVING (AAL) REFERENCE ARCHITECTURE AND ARCHITECTURE MODEL –

Part 1: Reference architecture

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
6) All users should ensure that they have the latest edition of this publication.
7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 63240-1 has been prepared by IEC systems committee AAL: Active Assisted Living.

The text of this International Standard is based on the following documents:

Draft	Report on voting
SyCAAL/176/CDV	SyCAAL/190/RVC

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts in the IEC 63240 series, published under the general title *Active assisted living reference architecture and architecture model*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

IEC SyC AAL is developing an architecture model and a reference architecture for AAL to guide the development and deployment of AAL services and technologies. IEC 63240 consists of the following parts, under the general title Active assisted living (AAL) reference architecture and architecture model:

- Part 1: Reference architecture;
- Part 2: Architecture model.

This document provides information to ensure usability and accessibility from the earliest stages of design and provides guidance to developers on how to incorporate these requirements. Additional requirements such as security, privacy, and trustworthiness are introduced and considered.

This document captures the results the work of SyC AAL on architecture and interoperability. This document reflects contributions and discussions by SyC AAL experts, mirror committees and liaison members. This document also contains material gathered from reports and group output from the SyC AAL meetings in November 2015 (Tokyo), April 2016 (Wellington), October 2016 (Frankfurt), April 2017 (Beijing), September 2017 (Cleveland), December 2017 (Eindhoven), May 2018 (Tokyo), October 2018 (Seoul), June 2019 (Frankfurt) and October 2019 (Shanghai), as well as information obtained during various web meetings.

Experts from liaison organizations and the following national committees have contributed: CA, CH, CN, DE, GB, IN, JP, KR, NL, NZ, SE, US.

The target audience for this document includes the following stakeholders who have an interest in the AAL system:

- AAL users and service provider personnel who can learn about AAL user needs and how to operate AAL systems;
- consumer electronics and information and communication technology device manufacturers who want to understand AAL devices and interface and interoperability requirements;
- stakeholders who are interested in the usability, accessibility and performance of the AAL system as well as AAL operators who need to understand the system requirements;
- regulators who are responsible for developing and supervising AAL and related regulations.

ACTIVE ASSISTED LIVING (AAL) REFERENCE ARCHITECTURE AND ARCHITECTURE MODEL –

Part 1: Reference architecture

1 Scope

This document specifies the AAL reference architecture.

This document defines concepts and introduces terminology. It provides generic rules for designers of AAL systems and services with the aim to facilitate systems design and enable interoperability between components.

This document identifies safety, security, privacy, and other requirements for AAL systems such as usability, accessibility, and trustworthiness (reliability, resilience).

2 Normative references

There are no normative references in this document.

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1.1
AAL device
material element or assembly of such elements intended to perform a required function used in an AAL service (IEV 871-01-04)

Note 1 to entry: There are 1) medical devices (IEV 871-06-06), as defined by regulatory agencies, 2) personal health devices and sensors (IEV 871-04-29) for fitness, well-being, personal comfort and personal security and 3) devices which can serve as aggregators of personal data produced by the user of the device.

[SOURCE: IEC 60050-151:2001, 151-11-20, modified – The term "device" has been replaced by "AAL device". In the definition, "used in an AAL service" has been added.]

3.1.2
AAL gateway
functional unit that connects two computer networks with different network architectures and protocols used in an AAL service (IEV 871-01-04)

Note 1 to entry: The computer networks may be local area networks, wide area networks, or other types of networks.

Note 2 to entry: Examples of gateways are a LAN gateway, a mail gateway used in an AAL service.

[SOURCE: IEC 60050-732:2010, 732-01-17, modified – The term "gateway" has been replaced by "AAL gateway". In the definition and in Note 2 to entry, "used in an AAL service" has been added.]

3.1.3
AAL platform backend system
AAL backend system
system that houses a number of components (functionalities) in order to collect the data from AAL gateways or AAL devices directly over a wide area network connection, and that can also implement components for the remote management of AAL gateway or AAL device (e.g. firmware update) and components for interfacing with AAL information systems or other information systems

3.1.4
AAL application
AAL application and services
program or application that interacts with the AAL users or within the network infrastructure to transmit or exchange data and information in the network

[SOURCE: IEC 61907:2009, 3.1.13 – modified. The term in the source entry is "(network) service function". In the definition, "network users" has been replaced by "AAL users".]

3.1.5
AAL user
person who uses or benefits from, or uses and benefits from, AAL devices, AAL systems or AAL services

[SOURCE: IEC 60050-871:2018, 871-02-05]

3.1.6
AAL service
action or function of an AAL system creating an added value for customers

EXAMPLE 1 Configuration and maintenance of AAL systems.

EXAMPLE 2 Assistant systems to support the home and living environment.

Note 1 to entry: An AAL service can consist of several individual services.

[SOURCE: IEC 60050-871:2018, 871-01-04]

3.1.7
AAL information system
collection of technical and human resources that provide the storage, computing, distribution, and communication for the information required by an AAL service (IEV 871-01-04)

Note 1 to entry: An AAL information system can contain various types of personal information.

Note 2 to entry: See http://whatis.techtarget.com/definition/IS-information-system-or-information-services [accessed 2020-10-20]. The definition is based on the first sentence, in which "IS (information system) is the " was omitted and "all or some part of an enterprise" was replaced by "an AAL service (IEV 871-01-04)". Note 1 to entry was added.

3.1.8
consumer electronics
CE
electronic devices designed to be purchased and used by end users or consumers for daily and non-commercial/non-professional purposes.

Note 1 to entry: Consumer electronics are among the most commonly used form of electronic, computing and communication devices.

3.1.9
information and communication technology
ICT
technology that comprises all devices, networking components, applications and systems that combined allow people and organizations to interact in the digital world

3.1.10
network connection
connection that comprises both local and wide area networks (e.g. LAN or internet).

3.1.11
interface
boundary between two functional units, defined by functional characteristics, signal characteristics, or other characteristics as appropriate

Note 1 to entry: This concept includes the specification of the connection of two devices having different functions.

[Note 2 to entry: IEC 60050-871:2018, 871-04-18]

3.1.12
other information system
collection of technical and human resources that provide the storage, computing, distribution, and communication for the information not specific to AAL services

Note 1 to entry: Health information system (HIS) can be part of an other information system. Examples of HIS include

- electronic health records (IEV 871-06-01),
- primary care practice electronic medical records (EMRs),
- pharmacy systems, and
- laboratory information systems.

Note 2 to entry: It is possible that AAL care recipients' data need to be shared with other information systems. For example, in the context of an AAL care recipient who is suffering from chronic diseases and is monitored at home by a telemonitoring system, it is possible that a vital signs summary report needs to be shared with the primary care physician's EMR.

Note 3 to entry: See http://whatis.techtarget.com/definition/IS-information-system-or-information-services [accessed 2020-10-20]. The definition is based on the first sentence, in which "IS (information system) is the " was omitted and "required by all or some part of an enterprise" was replaced by "not specific to AAL services". Notes 1 and 2 to entry were added.

3.2 Abbreviated terms

AAL active assisted living

ADL activities of daily living

AI artificial intelligence

IADL instrumental activities of daily living

IoT Internet of Things

4 General

AAL (active assisted living) is lacking an international standard on a reference architecture to serve as an abstraction of the domain. The objective is to give an overview of the basis for implementing concrete architectures for different families of AAL applications. The proposed reference architecture defines design and implementation of, for example, communication and data flow between AAL components and how the architecture should be constructed.

5 Relationship between IoT and AAL

AAL and IoT share a common technical architecture model and a technical "thing"-services-based framework with the emphasis on the AAL user who consumes or applies assisted living "thing"-related services. AAL is a specific use of IoT, if IoT is understood as the possibility of connectedness of things to each other. IoT is an enabler for other application systems and application domains. More specifically, it is an enabler for other "thing"-related services in these application systems and application domains.

AAL can be considered as one instance of a "human-centric IoT" approach. This means that the base for AAL is the IoT technical architecture, but specific or different requirements exist due to the user-centricity of AAL. In AAL, users include lay operators who are not IT professionals as users. There are also other IoT application domains that are human-centric such as the patient-centric medical thing-related services or healthcare thing-related services.

AAL is a human-centric use of IoT to create adapted localities (e.g. homes, points-of-care) with the aim of assisting humans. AAL is a human-centric domain at the point-of-care where services to people based on technical, IoT services are most commonly applied.

AAL utilizes IoT and designs thing-related services that serve the needs of an AAL user when interacting with the AAL cyber-physical system.

The AAL key requirements are safety, security, privacy, technical assistance and additional requirements (e.g. resilience and reliability of the system). These requirements can also apply to other domains where people play an important role such as the healthcare and medical domain.

Smart home and smart energy are domains in which domain-specific smart thing-based services are applied. "Smart services" of these and other domains should be interoperable and combined in processes which serve the need of the user of such "smart", connected services. AAL users can benefit from "smart", connected services in which AAL services are combined with services of other domains.

AAL systems are designed and implemented to assist people who are in need of AAL services realized by means of "things".

6 AAL reference architecture

6.1 Purpose of AAL reference architecture

The reference architecture defines concepts and introduces terminology on an abstract level. The reference architecture provides generic rules for designers of AAL systems and services with the aim to facilitate systems design and enable interoperability between components. The AAL reference architecture enables secure and interoperable AAL services (all AAL services, including end-to-end services) by describing the generic architecture. The purpose of the reference architecture is to develop a framework that provides an overall view on components and how they relate to each other, which enables users to fit use cases for AAL. Components could be actors, devices, and other building blocks. Thus, it describes connections between technical entities and associations of people to the technical entities.

The reference architecture is specific to AAL; however, it is not limited to current technological solutions and use scenarios.

6.2 Users of AAL reference architecture

Potential users of the AAL reference architecture are designers and developers of AAL systems and services, as well as manufacturers, procurers and all other stakeholders that are interested in an abstract framework that allows them to map their use cases.

Users should use the reference architecture during the development of use cases, AAL services, systems, or components and to better understand how different components can be interconnected.

User can develop guidelines for secure interoperability based on the reference architecture.

6.3 Description of AAL reference architecture

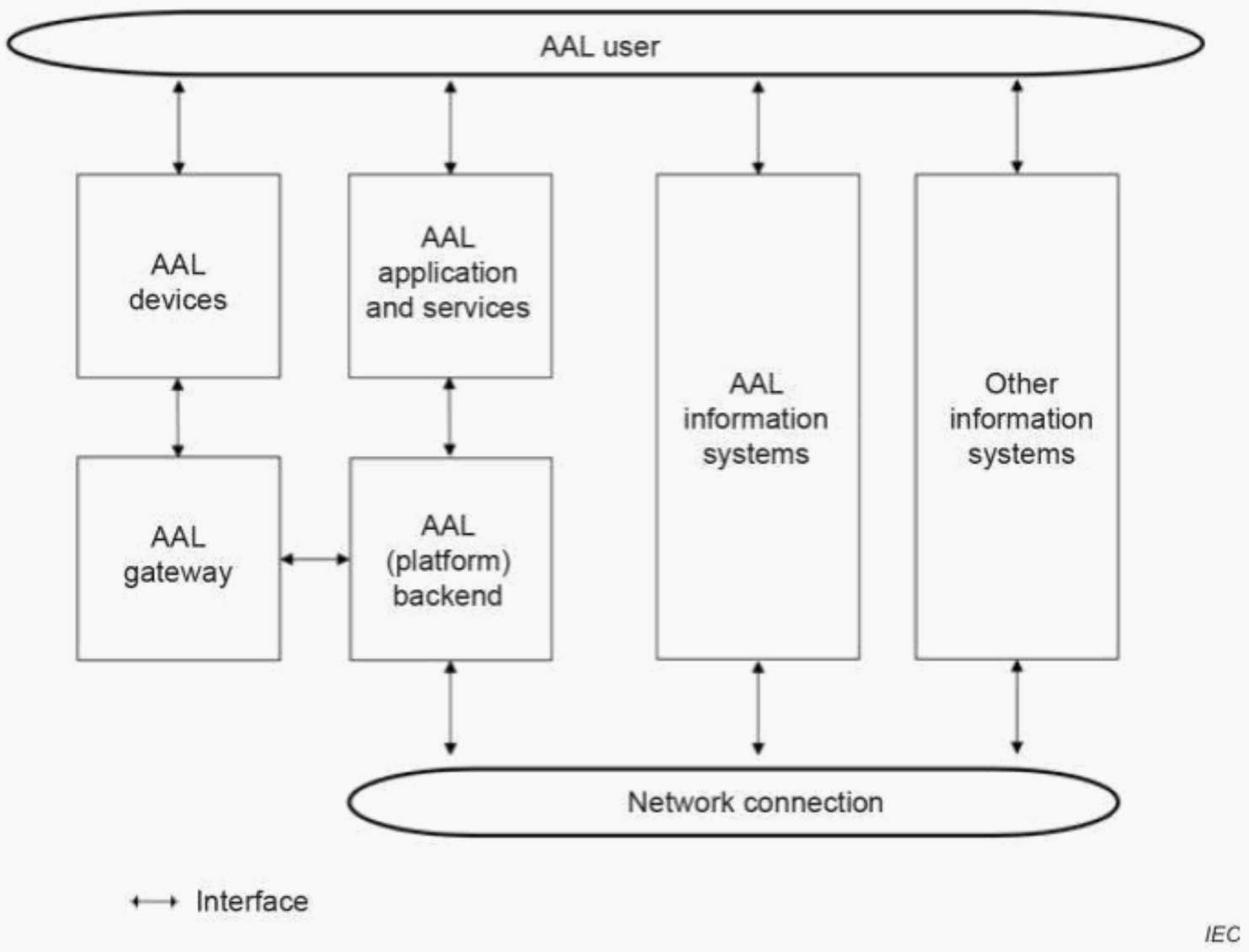


Figure 1 – Conceptual level of AAL reference architecture

Figure 1 depicts the AAL reference architecture on a conceptual level. There can be a user interface in every building block. It shows the flow of information from one building block to the next over defined interfaces of the reference architecture.

The AAL reference architecture consists of several building blocks. Building blocks are entities which are on their own or in combination with other entities capable of delivering AAL services. Building blocks are connected to each other by interfaces.

7 Security requirements in the context of AAL

7.1 General

Security and cybersecurity threats affect organizations, products and services. Security measures now focus on response time from attack rather than risk of attack. This need for a proactive response strategy is not likely to change in the foreseeable future. The traditional security defence strategy to layer one point-product tool over another has had to be rethought.

The development of intelligent immune systems in which enterprise security solutions work together to prevent and repair the damage cyberattacks can impose on an individual or an organization is essential. The essence of this comprehensive approach to security needs to be captured in IEC AAL standards.

Figure 2 shows the security process within the context of AAL standards.

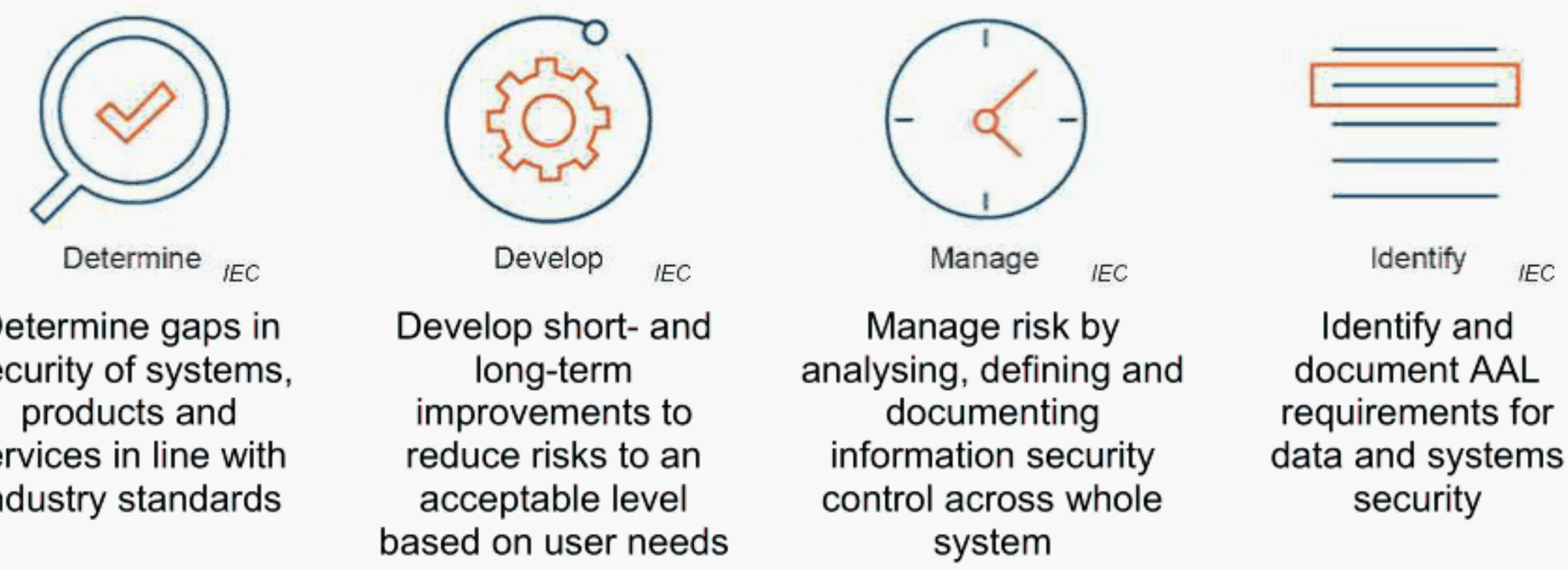


Figure 2 – Security process within the context of AAL standards

7.2 Privacy requirements

- Conduct privacy assessments and document privacy policies as required in national/regional regulations.
- Assess data subject rights to consent, access, correct, delete, and transfer personal data.
- Discover and classify personal data assets and affected systems.
- Identify access risks, supporting privacy by design.

7.3 Security requirements

- Assess the current state of security practices in AAL standards and identify gaps and design security controls.
- Find and prioritize security vulnerabilities, as well as any personal data assets and affected systems to design appropriate controls.
- Assess security current state, identify gaps, benchmark maturity, establish conformance roadmaps.
- Identify vulnerabilities, supporting security by design.

7.4 Areas relating to AAL security for consideration

- Mobile – transaction protection, device management, content security.
- Advanced fraud – criminal detection, identity fraud.
- Network – network forensics, firewalls and sandboxing, virtual patching, network visibility and segmentation.
- Data – data protection, data access and control.
- Product – usability, safety, interoperability and accessibility.
- Services – trustworthiness, security, privacy and accessibility.

7.5 Use of AI for cyberthreats

- Through the intersection of AI, intelligent orchestration, the agility of the cloud and collaboration, all managed within the discipline of AAL, developers can tackle the cybersecurity challenges ahead.
- Solutions using AI will specifically support AAL standards into the future.

7.6 AAL privacy risk examples

7.6.1 Monitoring location

There are several AAL provisions which detect a person's location through GPS, motion detectors, pressure sensors, etc., which can be either body-worn or static. But other provisions, such as smart meters and smart lightbulbs and many devices connected to the Internet, can also be used to ascertain a person's absence or presence and can increase risk to the person.

7.6.2 Monitoring health and well-being

Provisions range from self-monitoring of activity and physical status to medical monitoring of such aspects as blood sugar levels, home dialysis, heart function, fall detection, weight monitoring. All of these are vulnerable to accidental or deliberate disclosure, leading to such things as targeted advertising for health and weight loss products or taking advantage of loneliness via Internet dating sites. There can also be vulnerabilities arising from capture of information concerning behaviours and interests.

7.6.3 IoT

Interconnection of everyday devices enables them to send and receive data without the user being aware. Security of information can be compromised by weak protections, lack of updating, devices being used as proxy vehicles for the corruption of information and passing on computer viruses that lead to malicious activity affecting function.

7.6.4 Frame risks for the AAL system

- Risk assumptions (e.g. assumptions about the threats, vulnerabilities, consequences or impact, and likelihood of occurrence that affect how risk is assessed, responded to, and monitored over time).
- Risk constraints (e.g. constraints on the risk assessment, response, and monitoring alternatives under consideration).
- Risk tolerance (e.g. levels of risk, types of risk, and degree of risk uncertainty that are acceptable); and priorities and trade-offs (e.g. the relative importance of missions or business functions, trade-offs among different types of risk that organizations face, time frames in which organizations need to address risk, and any factors of uncertainty that organizations consider in risk responses).

Bibliography

IEC 60050-151:2001, *International electrotechnical vocabulary – Part 151: Electrical and magnetic devices* (available at http://www.electropedia.org/)

IEC 60050-732:2010, *International electrotechnical vocabulary – Part 732: Computer network technology* (available at http://www.electropedia.org/)

IEC 60050-871, *International electrotechnical vocabulary– Part 871: Active assisted living (AAL)* (available at http://www.electropedia.org/)

IEC 61907:2009, *Communication network dependability engineering*

IEC TS 63134:2020, *Active assisted living (AAL) use cases*

ISO/IEC 30141:2018, *Internet of Things (IoT) – Reference Architecture*

CEN-CENELEC-ETSI Smart Grid Coordination Group, "Smart Grid Reference Architecture," November 2012. [viewed: 2020-09-16] Available at: https://ec.europa.eu/energy/sites/ener/files/documents/xpert_group1_reference_architecture.pdf

J. Trefke, S. Rohjans, M. Uslar, S. Lehnhoff, L. Nordtrom, A. Saleem, "Smart Grid Architecture Model use case management in a large European Smart Grid project". Proc. IEEE PES ISGT Europe, 6-9 October 2013, Lyngby, Denmark (IEEE, 2013), https://ieeexplore.ieee.org/document/6695266

Status Report Reference Architecture Model Industrie 4.0 (RAMI4.0) July 2015. [viewed: 2020-09-16] Available at: https://www.zvei.org/fileadmin/user_upload/Presse_und_Medien/Publikationen/2016/januar/GMA_Status_Report__Reference_Archtitecture_Model_Industrie_4.0__RAMI_4.0_/GMA-Status-Report-RAMI-40-July-2015.pdf