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Review on current suitable standards

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Executive summary

KSERA is an artificial cognitive system used in Ambient Assistive Living capable to understand the real life situations thanks to the ubiquitous monitoring sub-system gathering the relevant data and parameters.
KSERA has the set of Rules permitting to set up the meaningful reactions delivered to the assisted person using the Robot.
The document describes the relevant standards determining the inter-operability of the KSERA system with the external applications which might be envisaged for the future exploitation of the KSERA results.

Purpose of this deliverable

D6.4 is the reference document containing the overview of the current suitable standards for KSERA. This deliverable explains how KSERA remain as open as possible considering the components and data flows bringing the awareness about the external conditions and the context.

The document speaks about the different classes of the devices and the Human Computer Interaction using the robotic device. Moreover the document mentions the standardisation of the User Profile and its Management.

Suggested Readers

This deliverable is intended for the KSERA consortium members and will be used in the system design, but it might be useful to the wide public.

Relationship to other documents

This deliverable is intended for the independent reading.

1 KSERA standardisation potential

Some of the KSERA partners are already involved in the passive and active standardisation processes, and consequently are participating in the activities of the standardization bodies. As an example of the active standardisation, partner ISMB plans to present the KSERA results to ETSI experts and groups of experts (STFs) involved in the creation of the new pan-European standards in order to inform them about the new implementations coming from KSERA, attempting to influence the above processes by the KSERA outcomes. Vice-versa, the KSERA consortium has the timely information about the useful standards, those already ruling the specific questions and those being discussed for the new adoptions.Several organisations and standards are relevant and will be taken into consideration both for application and possible extension.

Initially the set of the relevant standards possibly to be considered in KSERA was set, listing some healthcare, technical and user accessibilty related standards. Some of the standards are relevant to KSERA instance (platform), but some others are relevant to the more generic service model to be adopted for COPD care in the future. Among them:

- CEN (European Committee for Standardization Committee European de Normalization) 13606 - the European standard for Electronic Health Record. This standard is indirectly relevant to KSERA because treats the data protection aspects and the main issues relevant to the Remote Care Centres (Austria and Israel during the project timeline and the roll out options after the KSERA end). Therefore this standard is judged not in scope because not related to the KSERA platform being designed, the KSERA research prototype being experimented, the KSERA instance being validated as stand alone installation.

- HL7 - Health Level Seven, Inc. (HL7): ANSI accredited standards for the exchange of demographic and clinical information provides the syntax and semantics for interoperability. It is relevant because determining the inter-operability between KSERA and the Remote Centres. Since the link between the AAL/KSERA instance and the Service Centre's database needs to be mapped to the services being prototyped, the HL7 can impact at the interoperability of the services (at service level).

- CCD -Continuity of Care Document - CDA based CCR (Continuity of Care Record). This standard is not directly relevant to KSERA instance because relevant to the Remote Care Centre, populated by the data flow coming from KSERA.

- The DATSCG (Design for all and Assistive Technology Standardization Group). To ensure effective co-ordination between the ICT-related standardisation activities at European level in relation to design for all and assistive technologies. This standard will be used in the design stage to create the usable services.

- The ISO/IEC JTC1 - SC 35 covers standards on User Interfaces, and the SC35/WG 6 has also drafted reports on icons and symbols for use by elderly and disabled persons. (Technical reports, 19765 and 19766). This standard might become relevant while/if the marking of the objects will be required. Since the interaction between the KSERA user and the system is made through the robotic artefact, its compliance with the above standard is given by the market leader Aldebaran Robotics because of the final embodiment, which cannot be modified arbitrary from within the project timeline.

- ETSI the Technical Committee Human Factors (TC HF). The ETSI standard STF265 and the ETSI Guide EG 202 325 describe the concept and established a set of guidelines relevant to users

and their need for managing their user profiles to personalize their services and terminals. It is an example of the standard directly affected by the internal KSERA developments.

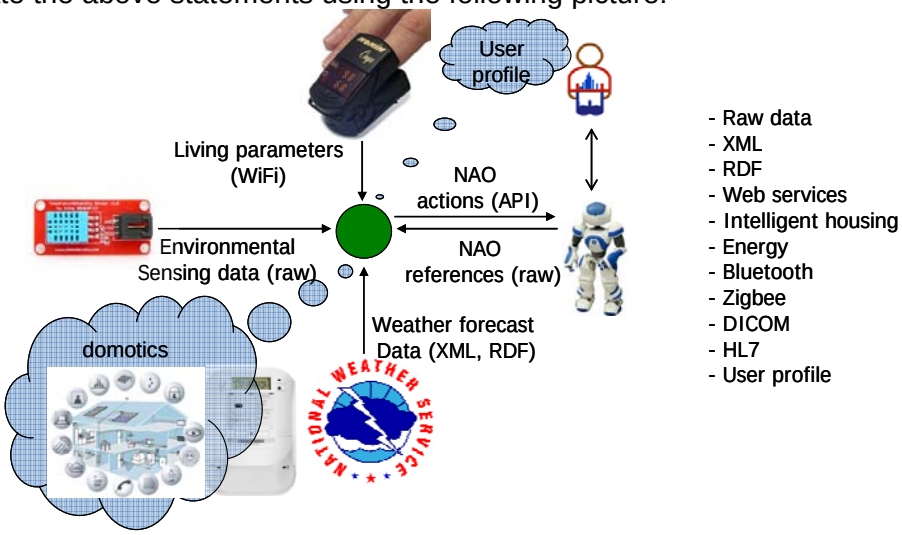
- ISO 13407, Human centred design processes for interactive systems. This set is used as the guideline during the project design and development because contributing to improve the inter-operability.

- ISO 9241, ISO usability metrics. This set is used as the guideline during the project design and development because contributing to improve the usability of the KSERA system..

2 Use of the standards in KSERA

2.1 Introduction

The KSERA system is an artificial cognitive system with decision making capabilities, those analysing the real life situations happening in the persons' (with COPD) home and neighbourhood/environment. We distinguish between the indoor and outdoor conditions simply because of the different classes of sensing used.
The discrimination between the concrete situations is made in KSERA because of the Rules encoded. KSERA Rules are described in the Deliverable D1.4. KSERA Rules are calculated using the Parameters measuring the concrete situations and conditions. The flow of the Parameters considered by KSERA is illustrated in the Deliverable D4.2.
We can illustrate the above statements using the following picture:



It becomes clear that the relationship between the KSERA sub-systems should remain inter-operable. Therefore the consideration of the inter-operability aspects calls for the relevant standardisation available in the respective sub-domains.

2.2 Data flows

In KSERA the system awareness about the real life events is realized through the data flows coming from the different environments:

1 User (Personal Area Network; devices for measurement of physical parameters mainly, like oxy-pulsimeters, FEV meters, blood pressure monitors etc.),
2 Intelligent House (Domotics),
3 Ubiquitous sensing (indoor),
4 Environment (outdoor weather conditions and PM10 levels),
5 NAO robot ("Robot Personal Area Network"), and
6 Service Centre (external care entity)

We will report the relevant standards separately for each class form the above five classes.

2.2.1 XML

The eXtensible Markup Language (XML) is a set of rules for encoding documents in machine-readable form. It is defined by W3C in the XML Specifications, and several other related specifications. It is an open standardisation available for free. XML is also de-facto leader, because it universally emphasizes simplicity, generality, and usability over the Internet.
XML is a textual data format, which can be parsed by any Web browser libraries, with strong support via Unicode for the different languages of the world. Therefore KSERA instance will be valid in Israel (non European language) and in any country matching the future commercial targets of KSERA.
Although the design of XML focuses on documents, it is widely used for the representation of arbitrary data structures, for example in web services and other Data Sets. Many Application Programming Interfaces (APIs) have been developed that software developers use to process XML data, and several schema systems exist to aid in the definition of XML-based languages.
Up to now (the Feb 2010 baseline, e.g. KSERA start date), more than over hundred of XML-based languages have been developed [source xml.coverpages.org/xmlApplications.html], including RSS, Atom, SOAP, and XHTML.
XML-based formats have become the commercial de-facto standard for the widely available “Office“ tools, including the Microsoft Office 2007/2010 (a.k.a. Office Open XML), the OpenOffice.org versions (a.k.a. OpenDocument), and also the Apple's iWork [source developer.apple.com/mac/library]. Therefore the use of the XML data sets in KERA will ensure the cross platform portability between Windows, and two major non-Windows environments. The orientation chosen by Apple paves also the compatibility vis-à-vis the future extensions of the iPads, iPods and other Apple specific developments.

2.2.2 RDF

RDF is not very distant from XML but offers some additional advantages. It is a standard model for *data interchange* on the Web, defined by W3C. RDF has features that facilitate data merging even if the underlying schemas differ, and it specifically supports the evolution of schemas over time without requiring all the data consumers to be changed. RDF extends the linking structure of the Web to use URLs to name the relationship between things as well as the two ends of the link (this is usually referred to as a “triple”). Using this simple model, it allows structured and semi-structured data to be mixed, exposed, and shared across different applications.

This linking structure forms a directed, labelled graph, where the edges represent the named link between two resources, represented by the graph nodes. This graph view is the easiest possible mental model for RDF and is often used in easy-to-understand visual explanations. More reading is available at www.w3.org/standards/techs/rdf.

The data formatted in RDF can be processed by many of the state-of-the-art tools. Let us report some of them because of the direct possible uses:

- 3Store. Triple store is a MySQL based store. This server software itself does not expose any interfaces directly to the user, but it can be queried by a number of services
- 4Suite is a programming environment, directly usable from Python (used in robotics and in NAO programming)
- ARC RDF Store is triple store directly usable from PHP (in robotics PHP plays and important role)
- Allegro Graph RDF Store is a triple store, programming environment, reasoner (reasoning engine, reasoning software), development environment, rdfs reasoner. Directly usable from Java, LISP, Python, Prolog. The licensing should be carefully analysed because impacting on the revenues from the future commercial exploitation

- BaseVISor is a reasoner, programming environment, rule reasoner). Directly usable from Java
- Bigdata® is a triple store, reasoner, rdfs reasoner, and owl reasoner. Commercial licensing applied
- Bossam is a reasoner, programming environment, and owl reasoner. Directly usable from Java
- Closed World Machine or CWM is a programming environment, rule reasoner, owl reasoner, command line tool). Directly usable from Python
- Hyena is a development environment
- Pellet Integrity Constraints is a validator
- Jena, is a Java RDF API and toolkit, e.g. triple store, programming environment, reasoner, rule reasoner, owl reasoner, rdfs reasoner. Directly usable from Java
- RDFS and OWL 2 RL generator service is a reasoner, programming environment, converter, owl reasoner, and rdfs reasoner, directly usable from Python
- Oracle Spatial 11g is a triple store, reasoner, owl reasoner, directly usable from Java
- Protégé is an editor, development environment, validator, and HCI tool (visualizer)
- RDFStore is a triple store, programming environment, directly usable from Perl, C
- Semantic Service Bus or SSB is a development environment
- sparql-wrapper is a programming environment directly usable from Python
- Virtuoso is a triple store, reasoner, rdf generator, sparql endpoint directly usable from C, C++, Python, PHP, Java, Javascript, ActionScript, Tcl, Perl, Ruby, Obj-C
- Watson is a search engine
- Wordpress PoolParty Thesaurus is a social media tool, directly usable from PHP

KSERA will pay attention considering RDF exports and RDF formatted data sets because facilitating the inter-operability with the external applications and services and specifically with the Semantic Web Universe.

2.3 User, persons with COPD

The COPD User assisted by KSERA system lives independently. Certain situations are triggered by the rules described in the Deliverable D1.4, those requiring the availability of certain parameters.

The above data are acquired from the devices from within the Personal Area Network. The above devices make available the data using the proprietary protocols and/or the open protocols via wireless.

2.3.1 IEEE 802.11, Wireless LAN, WiFi

This wireless communication is standardised as a family 802.11. Wireless LAN (Local Area Network) communication is based on the Ethernet protocol. It is highly robust and proven technology, available everywhere and free-to-use. The bandwidth is 108 Mbps, the frequency is 2400 MHz. The range is 10-30 meters from the access point indoor, or about 100 meters outdoors. The 802.11f protocol allows roaming, while any omni-directional antenna suits a Wi-Fi receiver. The legally permitted use limits the maximum transmission power, which must be less that 100mW.
Wi-Fi is a trademark of the Wi-Fi Alliance that manufacturers may use to brand certified products that belong to a class of wireless local area network (WLAN) devices based on the IEEE 802.11 standards. Because of the close relationship with its underlying standard, the term Wi-Fi is often used as a synonym for IEEE 802.11 technology. The Wi-Fi Alliance is a global, non-profit association of companies, promoting WLAN technology. It certifies products when those become conform to certain standards of interoperability. Not every IEEE 802.11-compliant device is submitted for certification to the Wi-Fi Alliance, sometimes because of costs associated with the

certification process. The lack of the Wi-Fi logo does not necessarily imply a device is incompatible with Wi-Fi devices. Several devices for measuring physical parameters are compliant with this standard.
Any Wi-Fi enabled device, including the personal digital nomadic devices coming from a given vendor, can connect to the Internet when they are within the range of a wireless. The coverage of one or more (interconnected) access points — called a hotspot — can comprise an area as small as a few rooms or as large as many square miles. Coverage in the larger area may depend on a group of access points with overlapping coverage. Routers that incorporate a digital subscriber line modem or a cable modem and a Wi-Fi access point, often set up in homes and other premises, can provide Internet-access and internetworking to all devices connected (wirelessly or by cable) to them. One can also connect Wi-Fi devices in ad-hoc mode for client-to-client connections without a router. Wi-Fi also enables places that would traditionally not have network access to connect, for example bathrooms, kitchens and garden sheds.
Wi-Fi also allows communications directly from one computer/device to another one without the involvement of an access point. This is called the ad-hoc mode of Wi-Fi transmission. This wireless ad-hoc network mode has been proven popular with multiplayer handheld game consoles, such as the Nintendo DS, digital cameras, other consumer electronics devices, and some medical devices. Similarly, the Wi-Fi Alliance promotes a pending specification called Wi-Fi Direct for file transfers and media sharing through a new discovery- and security-methodology.

2.3.2 IEEE 802.15.1, Bluetooth

Bluetooth or IEEE 802.15.1 is an open standard technology, associated to wireless personal area network (WPAN), for exchange data over short distance. It is mature, available everywhere, with the additional cost of some 5 dollars per device, very marginal considering the average price of the medical devices. The bandwidth is ~3Mbps at the standard frequency being 2,4 GHz everywhere. The area covered by Bluetooth is up to 100 meters. There are no infrastructural requirements and no legal issues.
Bluetooth is a short-range wireless connectivity global standard. This technology, in many cases, replaces the cables, needed to connect devices: printers, laptops, personal computers, PDAs, keyboards, joysticks, mouse, medical devices and all the devices can be connected to each other, delimitating a short range network called Personal Area Network (PAN).
Bluetooth is based on the Service Discovery Protocol (SDP) that makes one Bluetooth device able to determine which services the other devices (within the PAN) offer. A device implementing the SDP can work both as a server and as a client. In the first case, it can be asked by other devices about the available services. In the second case it enquiries other devices.
In a typical Bluetooth network, each device contains information about the services and the protocols it is able to support. Other devices can use this information in order to determine the possible interactions with the network. From the operational point of view the basic functions of the Bluetooth are: the enquiry, allowing knowledge about the surrounding devices, and the discovery and the browsing, for finding services and devices, their settings and requested connectivity parameters. Other relevant technical features that have driven the Bluetooth development are: worldwide working, peer-to-peer connection supported, both the data and the voice traffic enabled, low power consumption, small size radio transmitters, low cost and large affordability.
The frequency band is 2.4 GHz in the ISM band. In the USA and in the most part of Europe the frequency of 83.5 MHz is allowed and used to allocate 79 RF channels, each 1 MHz wide. This band is free and interference problems can occur. The equipments can belong to one of the 3 power classes:

- Class 1: wide range devices (up to 100 meters) and maximum transmission power of 20 dBm (100 mW).
- Class 2: ordinary distances devices (10 meters) and maximum transmission power of 4dBm (2.5 mW).
- Class 3: short range devices (10 cm) and transmission power of 0 dBm (1 mW).

The frequency hopping technique requires that the Bluetooth devices (communicating with each other) have to know and follow the same hopping sequence. The Bluetooth devices can work in 2 different ways, Master and Slave. Among master and slave devices, there are not differences, neither at the circuit nor at hardware level. The master chooses the hopping sequence. The slaves (that want to communicate with a master) have to synchronize time and frequency on the master hopping sequence. A group of slaves (working together and synchronized with the same master) form the so called Piconet. One Piconet may include one single master and maximum 7 active slaves, where active slave means one unit keeping synchronized with the Piconet master. The Bluetooth standard includes some operative modes allowing to virtually extends the range of one Piconet. Some devices, in order to limit the power consumption, can temporarily dissociate from the Piconet, but will periodically receive information from the master, and are able to actively come back anytime in the Piconet, if there is a free slot. Besides controlling the hopping sequence, the master dominates the transmission that means it decides when the devices of its own Piconet can transmit. With regard to this, Bluetooth distinguishes 2 kind of traffic: Voice and Data.
The master decides when the slaves can transmit, assigning some slots to the voice traffic and some others to the data traffic. Regarding the data traffic, one slave can only transmit a reply to one dedicated master transmission; in particular, if the master (during a data slot) transmits one packet to one specific slave, the next slot is automatically kept for a possible data transmission of that specific slave, regardless of the presence of data to transmit. In the voice traffic, any slave transmits within slots reserved to the master, regardless they have been recipients of the previous transmissions. Anyway the communication always occurs between one master and one slave, so that whenever one slave sends a packet to another one from within the same Piconet, it transits through the master device. This time slot division between 2 devices is called Time Division Duplex (TDD).
Since the number of active slaves composing a Piconet is maximum 7, it is possible extend the coverage making a bigger network, built by more piconets linked together. This kind of network is called Scatternet. The connection between one master device and one slave device is called link, and Bluetooth defines 2 different types:

- Asynchronous services or ACL (Asynchronous Connection-Less): this link exists when a connection between one master and one slave has been established. One master can have an undetermined number of ACL links with many slaves, but only one per slave. An ACL link sets a packet switching communication between master and slave: the packets are sporadically exchanged, i.e. when there are data to send from the Bluetooth stack higher levels. Per each slot, the master chooses which slave must send or receive, and this makes possible both asynchronous services and short-time services. Moreover, special types of packets exploit the retransmission schemas and the error control techniques, in order to improve the transmission efficacy. A slave can reply during the following slot using an ACL packet exclusively if it has been directly addressed. Due to the peculiarity of the RF transmission, all the slaves under the range of one master listen to its transmissions. If one listening slave fails decoding its own address in a given packet, it is not authorized to use the following slot for sending. A further option is the broadcast transmission of packets that can be received from all the listening slaves.

- Synchronous services, or SCO (Synchronous Connection-Oriented): this is a symmetric link among master and slave, reserved frequency and periodic data exchange as dedicated slots. A SCO sets a circuit switching between master and slave. One master can support up to 3 SCO links with 3 different slaves at once. One slave can support 3 SCO links with only one or two different masters. The packets sent by a SCO link can never be retransmitted. One slave can always reply to a SCO packet, within the dedicated slot, also if its address has not been decoded. Each device will have to schedule the ACL traffic, in order to respect the slot dedicated to the SCO traffic.

2.3.3 IEEE 802.15.4, Zigbee

The IEEE 802.15.4 or ZigBee is a technology associated to wireless personal area network (WPAN) and in pparticular, to sensor nets, due to its specific characteristic of low energetic consumption and low implementation cost. It is a mature technology, ubiquitously available everywhere, while the price is about 10 Euro per device, which is also marginal compared to the price of devices, which use the wireless connection. The throughput rate of 250kbps at 2.4GHz, 40kbps at 915MHz and 20kbps at 868MHz. ZigBee frequency is 868 MHz in Europe, 915 MHz in USA and 2,4 GHz everywhere, while the coverage ranges from 10 to 75 m. It is usually used in mesh networks so it would be necessary a gateway to centralize communications. There are no legal issues. ZigBee works with several ISM frequency bands according to which its transfer speed is set:

Frequency	***Band***	***Scope of application***	***Binary speed***	***Number of channels.***
2.4 GHz	ISM	Global	250 Kbps	16
868 MHz	ISM	Europe	20 Kbps	1
915 MHz	ISM	America, Australia	40 Kbps	10

In ZigBee the maximum range is up to 75 - 100 m, depending on the environment, because it has been optimized with a very improved radio design to get low costs, which makes it adequate for industrial and AAL uses. Its objective is applications that require safe communications with a low data-sending rate and maximization of battery life. Its principal characteristics are: low consumption because the slave nodes scheme runs in the sleep mode, mesh network topology or star/tree network, and the easy integration because the nodes can be created with few electronic resources. ZigBee uses physical level and access level (MAC) defined in the IEEE 802.15.4, whereas the rest of layers from the protocol stack are defined by ZigBee Alliance.

ZigBee Alliance is a non-profitable organization, with more than 100 companies (most of them semiconductor manufacturers), that has the objective of promoting ZigBee's development and implementation as a low cost wireless technology. Standing out companies such as Invensys, Mitsubishi, Honeywell, Philips and Motorola work on the establishment of a standard system of communication, via radio and bi-directional, applicable to domotic devices, building automation, industrial control, PC peripheral, toy business, medical sensors etc. This alliance's members justify this standard development to fill the gap existing underneath Bluetooth regarding transmission capacity and low consumption since Bluetooth standard is unable to be an optimum selection for sensor nets.

ZigBee allows implementing several network topologies: star, which is the most common one, mesh and cluster tree, although no device in the market is known currently which is able to support this last one. From a functional point of view, ZigBee nodes may be active, with full functionality, or passive, with limited capacities. The active ones normally operate as net coordinator or traffic routing nodes (wide networks), while the passive ones, due to their simplicity and reduced cost, work normally as sensors/actuators. Compared with other wireless technologies, ZigBee increases the range of devices connected to the same network. Every routing node may be in charge of up to 255 terminal nodes, and at the same time, all the routing nodes may be part of the network depending on the coordinating node which administers the interactions with the rest of nodes up to 65,536 theoretical nodes. Most of the time, the transceiver of these terminal nodes is slept in order to save consume less energy than other wireless technologies. However, the routing nodes must be always awake which may cause disequilibrium in the different network terminals' consume. ZigBee technology is mostly used in the home wireless automation or domotic. In effect, the range covered is 10-75 m. The Speed of transmission is up to 250 kbit/s, while the power of transmission is 1 mW. Likely, the most important for KSERA is the batteries life, which ranges from 100 to 1000 days. The less relevant is modulation, which might be B-PSK and/or OQPSK. The data protection is ensured using the AES algorithm.

Similarly to Bluetooth, the way ZigBee works is also based in a profile concept. However, not all the profiles proposed in the standard are defined and approved yet, and therefore, there is no device counting with all the advantages that this technology theoretically presents. Most of devices named as “ZigBee” (nowadays on the market) are in fact implementations of standard 802.15.4 which do not follow the profiles defined by ZigBee Alliance but others with a proprietary character defined by the manufacturers themselves.

IEEE 802.15.4 is the standard on which ZigBee’s physical and MAC layers are based. Its most important characteristics are: network flexibility, low cost and low energy consumption, although the data transmission capacity is not very high. Network synchronism is obtained by beacon frames that keep all nodes synchronized without listening to the communication channel continuously and optimizing this way its energetic consumption.

Speaking about the intelligent homes, nowadays there are many ZigBee certified products and platforms. It is predicted the development of more profiles which allow the suitable standard application in all those fields where it may be useful. The main domains widely populated by the ZigBee devices being used are:

- Building control and monitorization: access control, environmental conditions, security, illumination control (of KSERA direct relevance);
- People/patients monitoring (of KSERA direct relevance);
- Electronic of consumption: remote control, TV, DVD (ancillary in KSERA, but creating cross-synergies for the future integration activities);
- Home control: access, watering, illumination, heating (of KSERA direct relevance because of the complementary actuation actions);
- Internet of things: information services, interaction with objects (relevant to KSERA because of the future uses).

The improved interoperability because of the above standards together with the seamless (wireless) communication help building the KSERA system as less invasive s possible, suiting better the AAL purposes in general.

2.3.4 Oxy-Pulsimeter

The Nonin oxypulsimeter described in D4.2 can be selected for KSERA. The above device uses the mentioned wireless communication standard protocols (Bluetooth). No ad-hoc protocols are needed.

2.3.5 FEV Meter

The FEV metering device described in D4.2 can be selected for KSERA. The above device uses the mentioned wireless communication standard protocols (Bluetooth). No ad-hoc protocols are needed.

2.3.6 Blood pressure monitor

The Blood pressure measurement device described in D4.2 can be selected for KSERA. The above device uses the mentioned wireless communication standard protocols (Bluetooth). No ad-hoc protocols are needed.

2.3.7 1-LEAD ECG

The one-lead electro-cardiograph CORSIENCE's device described in D4.2 can be selected for KSERA. The above device uses the mentioned wireless communication standard protocols (Bluetooth). No ad-hoc protocols are needed.

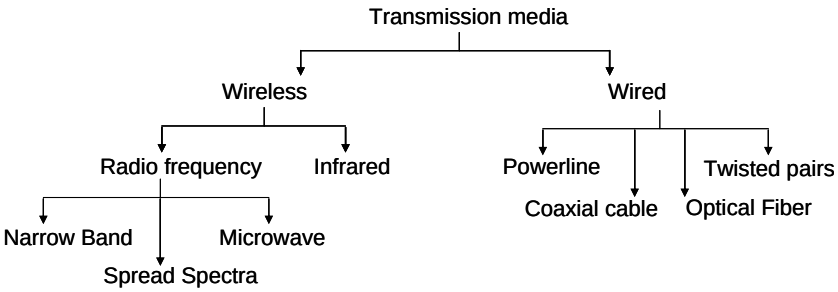
Therefore, all the medical classes of the devices selected for KSERA can be and will be interfaced using Bluetooth standard protocol ensuring the inter-operability.

N.B. The recommendation from experts is considered in full therefore.

2.4 Intelligent House, Domotics

In KSERA there is the data exchange between the Intelligent House environment (domotic system) and the main KSERA server. It is implemented as the connector to the Intelligent Home, and namely through the use of the Austrian e-Home implementation.

Smart home technology (domotic) can be considered as the integration of technology and services through home networking for a better quality of living (Definition according to the Smart Homes Association. Aim is to provide services and correlated benefits to the user in one or more of the following areas: Comfort (e.g. switching on / off light, pull up blinds, open windows, etc.), Energy management (e.g. heating & cooling control), Multi-media and entertainment, Healthcare (e.g. passive and active alarm systems), Security and Safety (e.g. access control, smoke detector, automatic night light when going to toilet), and Communication (e.g. door inter-communication).
Currently used types of transmission technology include: mains (e.g. EIB powerline, X10), bus (e.g. LonWorks, Konnex, Bticino), radio frequency (e.g. Bluetooth, Zigbee,), and infrared (as used in consumer electronics). The figure below (originally by Fellbaum 1999 and cited in Roe 2007) shows a classification hierarchy of transmission media.



Compared to wired technologies wireless technologies have significant advantages: much higher flexibility and easy installation. But there are also drawbacks: technical safety and security are lower than with wired networks, response times may vary significantly and some users may be concerned regarding RF emissions. Nevertheless, wireless technologies are in many cases the most attractive solution for installation in private areas.

2.4.1 X10

X10 is a protocol for powerline control of domestic electrical appliances (lights blinds, doors). X10 has a small range of commands and is used in private installations mainly.

X10 gives no possibility to control how the operation is executed. Therefore the "closing the door" operation cannot be assessed in full. It is possible to assess that the motorised lock was operated,

but the final result is unknown. It gives no certainty that after the execution of the operation the door will be closed.

2.4.2 LONWORKS, LONTALK

LONWORK (Local Operating Network, LON) is a proprietary standard of Echelon Corp., USA. LON indicates one communication technology making peer-to-peer network topology (not a bus) used for the networking of decentralized nodes. It bases on standard protocol LonTalk™ ANSI/EIA 709.1, EN 14908.1. Each device communicates with others nodes with no need of the server. It is used since 1990 for controlling and steering complex machines and large buildings. Originally based on the specifications X-10 and EIA 709, it works with a variety of different transmission media.

2.4.3 EIB

EIB (European Installation Bus) is an open standard widely used in Europe for smart homes, works on different media as powerline, twisted pair and radio frequency.

2.4.4 KONNEX

Konnex (KNX) is a new standard based on a merge of EIB, EHS and Batibus. KNX complies with the European Standard for Home and Building Electronic Systems (EN 50090).

2.4.5 HOMEPLUG

HomePlug AV is a Broadband Powerline technology. HomePlug devices are available on the market offering high transmission data rates, but at high cost per communication device. HomePlug is not compliant with CENELEC EN 50065 (A-band). General disadvantages of using BPL technology in smart metering are the high cost per communication device and an oversized data rate for transmitting metered data. A further drawback is the doubt about electromagnetic compliance when deploying such devices nationwide (due to the use of a frequency range reserved for short wave communication).

2.4.6 IEC 61334

In the Home automation context, IEC 61334-5-1 standard PLC technology provides a simple, yet robust communication scheme that complies with CENELEC EN 50065 (A-band). S-FSK is expected to be robust against the adverse communication channel conditions in the A-band of CENELEC EN 50065. Utilizing the zero crossings of the mains voltage as a reference for the TDMA scheme adds to the robustness, because synchronization can be achieved independent of the receive signal. Phase detection is not explicitly available, but could be obtained from the information about the zero crossing. The most prominent advantage of IEC 61334-5-1 is that it is standardized and has been implemented in commercial systems, therefore, it has a high level of interoperability, e.g. ON-SEMIs solution AMIS 30585 implements IEC 61334-5-1 for the CENELEC A-band and is currently available on the market. The major disadvantage of IEC 61334-5-1 is that the physical layer data rate is limited. Theoretically, a maximum PHY data rate of 2400 bit/s could be achieved. Due to the larger symbol duration and thus higher level of resilience against additive noise commonly expected on PLC links, we assume that 1200 bit/s is a more realistic value. Furthermore, the rather short and inflexible frame structure with a maximum SDU size of 38 bytes is assumed to cause comparably high latency times, especially if combined with repeating.

2.4.7 Short range communication

Short Range Radio wireless technologies are strong in the assessment mainly in the cost issue, performance and security. However, the main drawback of these technologies is that there are many competing proprietary and open solutions, so the level of standardization is low.

2.4.8 IEEE 802.15

Again, IEEE 802.15.4 wireless technology has obtained good results in many key areas of the technology assessment, being open and standardized, low cost, robust and secure. Even though the data rate offered by this technology is not very high compared to other technologies (up to 250 kbps), it seems good enough to withstand future application band-width increase demands. In addition, this technology permits very low power consumption and battery life, which is an important factor for the Multi Utility Meter.

2.4.9 Wireless M-Bus

Wireless M-Bus wireless technology has solid performance in most of the areas covered in the assessment process. It is standard, proven, aimed at metering applications, and cost effective. Only the low data rates offered by the technology suppose a handicap, where the aspect of “future proof” technology has a significant weight, and other technologies offer better performance to cost ratio.

Smart home systems which support different media types are flexible and allow using the media best suited for the transport of messages (e.g. Twisted Pair in new installations, Power Line or Radio Frequency in existing homes). For some systems (e.g. Konnex, Lonworks) it is also possible to transfer datagrams as part of IP messages. This allows to link the domotic system with the global internet. Current smart metering solutions exploit the powerline communication (PLC), which are sufficiently mature and well described in literature. With respect to communication system performance and appropriateness of each of the technologies to the specific properties of the PLC transmission channel, the proprietary solutions adopted by the major utilities hide the details because of the business dimension.

2.4.10 RS485

RS485 serial interface is based on a differential balanced communication line with a typical impedance of 120 ohms. The maximum achievable length of the link depends on communication speed, signal to noise ratio and cable quality: it is generally specified as 1.200 meters. An unshielded twisted pair can be used on short distances if the electrical environment is not too noisy. For distances between 15 and 100 meters any shielded twisted pair will work, but for longer links a high quality low loss cable like CEAN CPR 6003 or BELDEN 9841 is suggested. All the slaves should be arranged along the line; star connections must be avoided and line branches, if any, must be kept short (see figures). A termination resistor (typical value 120 ohm) must be inserted in parallel with the last slave at the end of the line. The cable shield must be connected to the 0 terminals and grounded at one point only (preferably on master side).

2.4.11 MODBUS

MODBUS (ASCII, RTU, JBUS) ® is an application layer messaging structure developed by Modicon in 1979, used to establish master –slave communication between intelligent electric devices. It is a truly open and de-facto established standard RS485, making it the most widely used network protocol in the industrial manufacturing environment. MODBUS protocol, positioned at level 7 of the

OSI model that provides client - server communication between master and slave devices connected on different types of buses or networks used for transfer of data between the mentioned devices. The Internet applications can access MODBUS through TCP/IP stack using the port 502. MODBUS is a re-quest/reply based protocol offering its services through the function calls. The Master de-vice always initiates a read/write request to which the Slave device responds. The Slave device never transmits anything on its own – it must be triggered with a request.

2.4.12 E-HOME

There is the following protocol between KSERA and the eHOME system for data exchange in T4.2. Presuming that from KSERA to eHOME we need to pass only little information in both directions, e.g.

- Sensor/actuator id (unsigned integer/symbolic name)
- Data value (integer/function)
- Maybe timestamp (unsigned longlong milliseconds since 1.1.1970/date string)

The interfaces are:

1) eHOME SOAP type (as used now)
   eHOME type SOAP, see definition in ehome_act.wsdl (to eHOME for actuator commands) and ehome_sens.wsdl (to KSERA for sensor data push)

2) Simplified REST type GET interface like it is used for beamer
- http://KSERA-PC/rest?sensor=123&data=456&timestamp=789 (to KSERA for sensor data push)
- http://EHOME-PC/rest?actuator=123&data=456&timestamp=789 (to eHOME for actuator commands)

The parameter values can also be non-numerical identifiers like “sensor2” or “on”.
Also PUT access with XML data structure would be possible.

2.5 Ubiquitous sensing, Indoor

KSERA direct sensing is embedded in the Ubiquitous Monitoring sub-system which is designed keeping in mind the above interoperability questions. The implementation will be proprietary, however the interoperability will be ensured because writing all the data in the relational database. The format of the data being written in the database is known and fully documented in KSERA documentation, so the data can be retrieved and the datasets can be processed by any software components.

The main sensors contributing in the KSERA PT1 implementation with the data are those belonging to the class of the Temperature and (relative) Humidity sensors. The datasets manilupated are the sequences of the numeric values carrying the following attributes, suiting XML and RDF encoding.

Temperature = { (T_0, t_0), …, (T_i, t_i) }, where T_i are the Temperature values, and t_i are the timestamps.

Humidity = { (H_0, t_0), …, (H_i, t_i) }, where H_i are the Humidity values, and t_i are the timestamps.

Therefore the aggregation of the Dataset is possible as <XML/RDF … (H_0, T_0, t_0), …, (H_i, T_i, t_i) …>.

2.6 Environment, Outdoor

In KSERA, NAO should discriminate between the normal outdoor conditions and those potentially harmful to COPD patient when venturing outdoor. Some activities, such as walking, going to museum and similar, can be postponed if the external conditions are not aligned with the safety levels. However, certain activities, such as buying food in the nearest supermarket, cannot be eliminated at all or postponed in an indefinite manner. Therefore KSERA should estimate the future weather conditions in PM10 terms using the external sources of the information coming from the weather forecast, direct observations made available through the web services.

2.6.1 Environment, Outdoor

A web service is a specific method permitting the communication between two, or more, electronic devices exploiting the web paradigms. The W3C defines a web service as "a software system designed to support interoperable machine-to-machine interaction over a network. It has an interface described in a machine-processable format (specifically Web Services Description Language - WSDL). Other systems interact with the web service in a manner prescribed by its description using SOAP messages, typically conveyed using HTTP with an XML serialization in conjunction with other Web-related standards". The W3C also states that, "we can identify two major classes of Web services, REST-compliant Web services, in which the primary purpose of the service is to manipulate XML representations of Web resources using a uniform set of "stateless" operations; and arbitrary Web services, in which the service may expose an arbitrary set of operations".
Web services enable quick integration of the applications across multiple platforms, systems and even across different businesses. Web services standards such as SOAP, WSDL and UDDI enables system-to-system communication that is easier and cheaper than ever before.

KSERA in the first implementation does not plan the installation of the external, outdoor, sensors for PM10 measurements, directly used in the KSERA Rules to discriminate if the COPD can venture outdoor or not. Therefore KSERA adopts the external web services as the virtual sensors offering the needed sequences of the numeric values.

One relevant example concerning the weather forecast can be found online at the http://www.webservicex.net/ws/WSDetails.aspx?CATID=12&WSID=56 web portal. The respective schema is available online at the above web portal, while the WSDL Schema Location is available on http://www.webservicex.net/globalweather.asmx?WSDL

KSERA uses the following operations:

- GetCitiesByCountry(): get all major cities by country name(full / part)
- GetWeather(City): get weather report for all major cities around the world.

It is important to recall the fact that a formal definition comes from the service provider, therefore the description of the concrete implementation, for example Webservicex.Net.GetCitiesByCountry() is available online at www.webservicex.net portal.
KSERA have to select the concrete web services providing the data about the outdoor situations in Israel and Austria locations after those being selected for the experimentation (D5.1). KSERA might consider the remapping of the data sets whenever it is necessary to match the above Service Description from outside.

2.7 NAO Robot artefact

The NAO Robot has to interact with the persons with COPD sharing the same living space. Therefore NAO should communicate its position from within the environment in order to allow the calculation of the non-invasive co-existence. The data flow is exchanged using the Wireless connection between the industrially standardised robot instance (Aldebaran Robotics, www.aldebaran-robotics.com) and the KSERA system. Aldebaran is the world leader for small humanoid robots and as such has defined a standard in the range of affordable small humanoids which are used from RoboCup Standards to help scenarios in ambient environments.

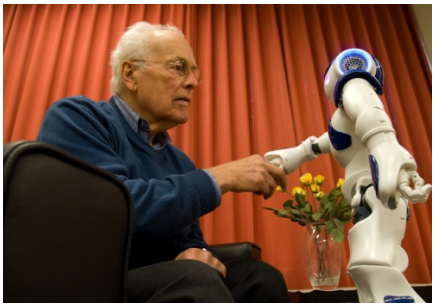
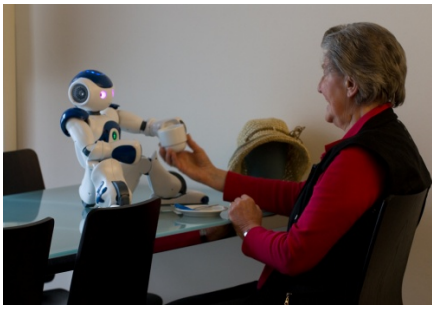
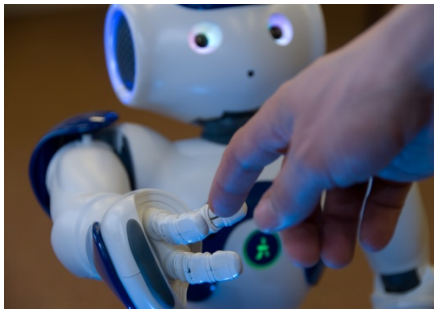
The NAO positions are numerical sets (Xi, Yi, Pi) denoting X-, Y- position and a rotation angle, while the other data structures relevant to the project are those described in the Aldebaran Technical documentation, also available online in the Support Web Portal of Aldebaran Company. Sensor values from the robot are retrieved, and motor values to the robot are written via Aldebaran's proprietary SDK "NaoQi".

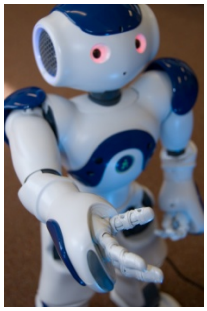
In KSERA, the NAO Robot is the computerized artefact having the capability to move and interact with the COPD patient. The actuation of the NAO mobility is made using the dedicated APIs made available by Aldebaran Robotics. The APIs are described on the following web page:http://robocup.aldebaran-robotics.com/docs/site_en/index_doc.html
The "Blue" documentation describes the NaoQi API. Specifically NaoQi supplies modules ALMotion for joint control and navigation, ALTextToSpeech for voice synthesis, ALVideoDevice for retreiving images from the NAO cameras and additional modules for further built-in functionality of the NAO robot.

NAO mobility is represented by the method walkTo of the NaoQi module ALMotion. This method has three parameters and is invoked as walkTo (X, Y, P). It lets NAO walk by X forward, by Y sideward (units are in meters) and lets NAO turn by an angle P (units are radians), based on the current position NAO_At(Xi, Yi, Pi) at time i. The position of Nao will then be updated according to the status transition from time i to time j, such that Xj = Xi + X, Yj = Yj + Y and Pj = Pi + P at time j. Relevant to the interaction between NAO and the user is the distance between NAO's position NAO_At(Xi, Yi, Pi) and the user's position HUMAN_At(Xi, Yi, Pi).

Regarding the use of NAO, there are no specific standardisation issues that KSERA deals with, because the NAO use is totally constrained by the Aldebaran APIs, making this the de-facto standard.

Some examples of the interactions between older persons and NAO are reported on the following pictures.

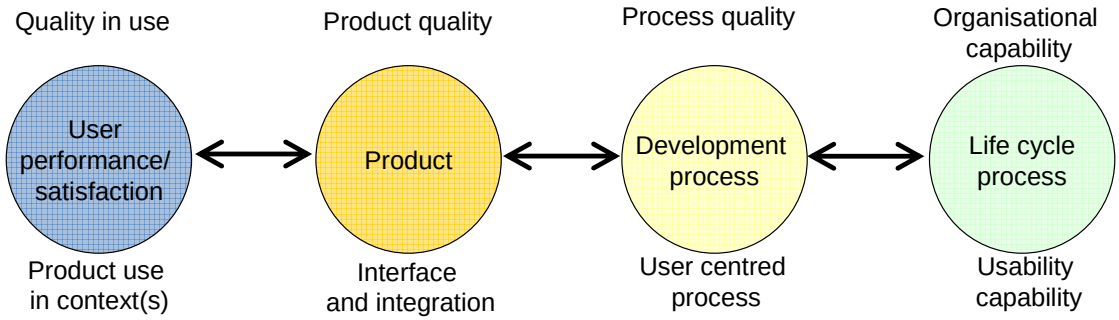


2.8 ISO 13407

ISO 9241-210:2010 provides requirements and recommendations for human-centred design principles and activities throughout the life cycle of computer-based interactive systems. It is intended to be used by those managing design processes, and is concerned with ways in which both hardware and software components of interactive systems can enhance human–system interaction. The last revision available is ISO 13407:1999. Considering the absence of the relevant updates during the significant period of time, the current use might be constrained by the status "Withdrawn", as stated at the respective holder's web site
www.iso.org/iso/catalogue_detail.htm?csnumber=21197.

2.9 ISO 9241

ISO 9241 is a multi-part standard covering a number of aspects for people working with computers. Although originally titled Ergonomic requirements for office work with visual display terminals (VDTs) it is being modified to the more generic Ergonomics of Human System Interaction by ISO. As part of this change, ISO is renumbering the standard so that it can include many more topics. The first part to be renumbered was part 10 (now renumbered to part 110). Part 11: Guidance on usability is of KSERA interest because determining the usability of the commercial services being instantiated on top of the KSERA service delivery platform.



The most recent document ISO 9241-11 is dated 1998. This part deals with the extent to which a product can be used by specified users to achieve specified goals with effectiveness (Task completion by users), efficiency (Task in time) and satisfaction (responded by user in term of experience) in a specified context of use (users, tasks, equipments & environments).

In KSERA, the specificity of the COPD user needs to be evaluated specifically during the field trials in Austria, Israel and in any of the lab trials. This standard provides the definition of usability that is used in subsequent related ergonomic standards: "the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use". ISO 9241-11 gives KSERA the right tool to identify the information that it is necessary to take into account when specifying or evaluating usability in terms of measures of user

performance and satisfaction. Guidance is given on how to describe the context of use of the product and the measures of usability in an explicit way. It includes an explanation of how the usability of a product can be specified and evaluated as part of a quality system, for example one that conforms to ISO 9001.

The above standard also explains how measures of user performance and satisfaction can be used to measure how any component of a work system affects the quality of the whole work system in use (ISO/IEC 9126: Software product evaluation - Quality characteristics and guidelines for their use, dated 1991). In the software engineering community the term usability has been more narrowly associated with user interface design. ISO/IEC 9126, developed separately as a software engineering standard, defined usability as one relatively independent contribution to software quality associated with the design and evaluation of the user interface and interaction: “a set of attributes that bear on the effort needed for use, and on the individual assessment of such use, by a stated or implied set of users.” [ISO/IEC FDIS 9126-1: Software Engineering - Product quality - Part 1: Quality model (2000)].

ISO/IEC 9126 (1991) has recently been replaced by a new four part standard that has reconciled the two approaches to usability. ISO/IEC 9126-1 describes the same six categories of software quality that are relevant during product development: functionality, reliability, usability, efficiency, maintainability and portability. Therefore the new meaning of the usability becomes “the capability of the software product to be understood, learned, used and attractive to the user, when used under specified conditions.” The standard now recognises that usability plays two roles: a detailed software design activity, implied by the definition of usability, and an overall goal that the software meets user needs, similar to the ISO 9241-11 concept of usability [Bevan 1999).

ISO/IEC 9126-1 uses the term "quality in use" for this broad objective: “the capability of the software product to enable specified users to achieve specified goals with effectiveness, productivity, safety and satisfaction in specified contexts of use”. Quality in use is the combined effect of the six categories of software quality when the product is in use. The overall objective is to achieve quality in use, both for the end user and the support user. Functionality, reliability, efficiency and usability determine quality in use for an end user in a particular context. The support user is concerned with the quality in use of maintenance and portability tasks. More update is available on [www.usabilitynet.org/tools].

2.10 External Care entity

The assistive role of KSERA sees the cooperation with the healthcare professionals. MACABI is an example of the entity running the Service Centre, managing the patient data database and offering the remote assistance to COPD patients, if any.

KSERA system is an autonomous entity, not identifying the patients (mono-patient instance), not taking any medical decision about the anonymous data available. There might be some data exchange between the KSERA instance and the remote Service Centre. For the above purposes the HL7 protocol might become relevant because determining the inter-operability with the healthcare data centres.

2.10.1 HL7

Founded in 1987, Health Level Seven International (HL7) is a not-for-profit, ANSI-accredited standards developing organization dedicated to providing a comprehensive framework and related standards for the exchange, integration, sharing, and retrieval of electronic health information that supports clinical practice and the management, delivery and evaluation of health services. HL7's 2,300+ members include approximately 500 corporate members who represent more than 90% of

the information systems vendors serving healthcare. HL7 aims to create the best and most widely used standards in healthcare.
HL7 provides standards for interoperability that improve care delivery, optimize workflow, reduce ambiguity and enhance knowledge transfer among all of our stakeholders, including healthcare providers, government agencies, the vendor community, fellow SDOs and patients. In all of our processes we exhibit timeliness, scientific rigor and technical expertise without compromising transparency, accountability, practicality, or our willingness to put the needs of our stakeholders first. "Level Seven" refers to the seventh level of the International Organization for Standardization (ISO) seven-layer communications model for Open Systems Interconnection (OSI) - the application level. The application level interfaces directly to and performs common application services for the application processes. Although other protocols have largely superseded it, the OSI model remains valuable as a place to begin the study of network architecture.
HL7 is a structured protocol that is used as a means of communicating between healthcare applications. It is event-driven. Real-world events, such as the admission of a patient, cause messages to flow between applications. In other words, an application that encounters a real-world event sends a message to other applications that need to be aware of this event.
L7 defines a communication between two independent applications, rather than between closely coupled, client/server applications. The scope of interest for HL7 is the message exchange between the applications, rather than the specific role of each application in the healthcare delivery process.
HL7 is a messaging format that is independent of its transport method. However, it is typically used in a client/server environment for employing some form of a point-to-point protocol. For instance, HL7 can use the LLP Transport method to transfer messages between a client and a server. However, since a client must establish a connection to a server before a message can be sent, the client must have prior knowledge about the server. It is not normal for HL7 messages to use a non point-to-point protocol, where the client listens for 'broadcasts' from a particular server.
OSI Level 7 indicates that HL7's scope is the format and content of the data exchanged between the applications rather than how the messages are transmitted between computers or networks. In other words, HL7 does not specify how messages will be delivered between the applications. Usually a TCP/IP connection or FTP file transfer is used to deliver a message. However, within local area networks, the de facto standard is the Lower Layer Transport Protocol.
HL7 specifies the way data exchange between applications will be accomplished. It does not specify how applications store or process this data. It would be advantageous for an application developer if their application's database structure coincided with HL7 message definitions, but this is not mandatory.

Therefore, KSERA will not create a proprietary, non-standard link between two systems, KSERA and the remote care centre, situated in Israel, suiting the current experimentation needs, but KSERA considers the inheritance from the existing de-facto standard links instead.
KSERA investigates and creates a message exchange system that better suits the COPD personal needs and better fits the data structure of your application, requiring the common mapping onto the real life system of MACCABI in Israel.
As a result, the efforts invested in this link will not be useless when considering a connection to other third-party systems in future (exploitation being envisaged): using HL7 means that KSERA initial development effort can be reused again and again.

Maccabi operates a 24 hour call center for members to check their eligibility for services, to answer questions about physicians and other services — including locations, times of service and setting up appointments as necessary . This call center has nurses available in case questions are medical in nature and they, in turn, if necessary can call a physician to consult with him.
For KSERA Maccabi will give the users a telephone number that will go directly to the nurses on duty in KSERA call center during normal working hours. The nurse will answer the users questions and, if necessary, will consult with a nurse or physician specifically assigned to KSERA. After normal hours (1600) phone calls will be diverted to a duty nurse who is acquainted with KSERA and who will answer the call and refer to a physician or other member of KSERA term as indicated. In this way users will have access to telephone assistance, as needed. If the nature of the call is

technical, having to do with the sensors, NAO or other equipment we will have a backup person who is familiar with the KSERA system.

The KSERA solution does implement the service model linking the remote care service. In Israel the Call Centre is run by the MACCABI, while in Austria the KSERA remote centre will be conceptually identical. Its effective implementation currently does include the internal RALTEC's call centre. Currently, RALTEC considers the replication of the Maccabi service to keep the inter-operability. The above "call center" means there will be the 24h 7/7days maintainance by the researchers, in case of any problem concerning the system, questions or of course also participants' problems. In the case of need, RALTEC will have the real call center connection via phone line as well.
Therefore the call centre in Maccabi and the RALTEC ones will be compliant with and will inherit from HL7.

2.11 ETSI standards

ISMB as a full member of ETSI has contributes brought to some ETSI standards. Specifically an ETSI Standard (ES) on standardized objects related to personalization and user profile management was developed considering the rule definition language for defining automatic activation of profiles and a common terminology. It might become relevant in the commercial stage when the KSERA application/service will be considered for the roll out. The KSERA prototype is not affected by the above standard because it is mono-patient. The relationship between the KSERA instance and the COPD Remote Service will appear in the exploitation stage of the project, and will consider the above standard.
The virtual objects related to a range of services and devices with the goal to suit all users' needs including disabled, young and elderly people might be also considered in the exploitation stage when considering the transferability of the KSERA results in other domains.
The service developers and device manufacturers who wish to develop services and devices that can be personalized by their customers, as defined by the user profile management concept described in EG 202 325 "Human Factors (HF); User Profile Management", will be affected by the above standard. The standard is released and currently known as ES 202 746 (2010).

The above standard is accompanied by a Technical Specification (TS) on issues related to networks, terminals and SmartCards. The profile providers, telecom companies and device manufacturers who will implement and provide the underlying infrastructure and architecture of network and devices necessary to achieve the user profile management concept described in EG 202 325 "Human Factors (HF); User Profile Management" will be called in the commercial stage of the KSERA. The latest text is available from ETSI as TS 102 747.

2.12 Conclusions

We have overviewed the status of the relevant standards at the time being, extending the initial set of the standards reported in the B3.2 section of the KSERA DoW. The KSERA inter-operability will be ensured respecting the above standards in the project implementation stage.

2.13 Acknowledgements

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