

Continua: An Interoperable Personal Healthcare Ecosystem

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Continua: An Interoperable Personal Healthcare Ecosystem

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The healthcare industry must improve its delivery methods and reduce costs to address current and anticipated needs (see the “Healthcare Needs” sidebar). Various technologies could help by extending treatment and care beyond traditional clinical settings into personal and home settings. However, creating such a personal telehealth ecosystem will require interoperability. Device connectivity to enterprise services is currently very proprietary.

In an effort to develop interoperability guidelines for the emerging personal telehealth ecosystem, we formed the Continua Health Alliance (www.continuaalliance.org), an international alliance of more than 133 companies. The guidelines will be based on a comprehensive set of industry standards, which will serve as a blueprint for integrating a product into the ecosystem.

INTEROPERABILITY THROUGH INDUSTRY STANDARDS

Figure 1 gives an example overview of a typical ecosystem of personal telehealth devices and services. Continua aims to enable the alignment of different vendors and domains, focusing on

- disease management: managing a chronic disease outside of a clinical setting,
- aging independently: using technology and services to live in your own home longer, and

- health and fitness: expanding personal health and wellness to where you live and play.

The process Continua uses to develop its interoperability guidelines is centered on the use of industry standards. It starts by evaluating member-submitted use cases about interoperability problems related to one of the three focus areas. It then collapses the submittals

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into a consolidated, generalized list of use cases. Continua uses this list to prioritize capabilities, interfaces, and devices and then derives the desired functionality and requirements for the next version of the guidelines.

After this, Continua canvasses the healthcare industry for existing standard development organizations (SDOs) and standards that best satisfy questions such as

- How well do the standards address the capabilities in the selected use cases?
- Does the SDO have international standards or a path to generate them?

- Can Continua member companies participate in the SDO?
- How well is the standard harmonized with related domain standards?
- What are the specification access and control mechanisms?
- What is the associated intellectual-property model?
- Is there tool support?
- What is the level of adoption and maturity?

Once Continua selects the candidate standards, it compares them against the requirements to identify and address any gaps.

Ultimately, the interoperability guidelines will define profiles over the standards and serve as a basis for product certification. To ensure compatibility, Continua is establishing a certification and testing program that will include a detailed set of test specifications and automated testing tools so that candidate vendors can verify compliance. Additionally, interoperability events will ensure that products from different vendors work together. A product that passes the certification and testing program will receive certification and can display the Continua interoperability logo.

The ecosystem also touches on other crucial areas. For example, Continua has been collecting trial data from the US and Europe for the past five years to demonstrate the benefits of the interoperable healthcare ecosystem to insurance pro-

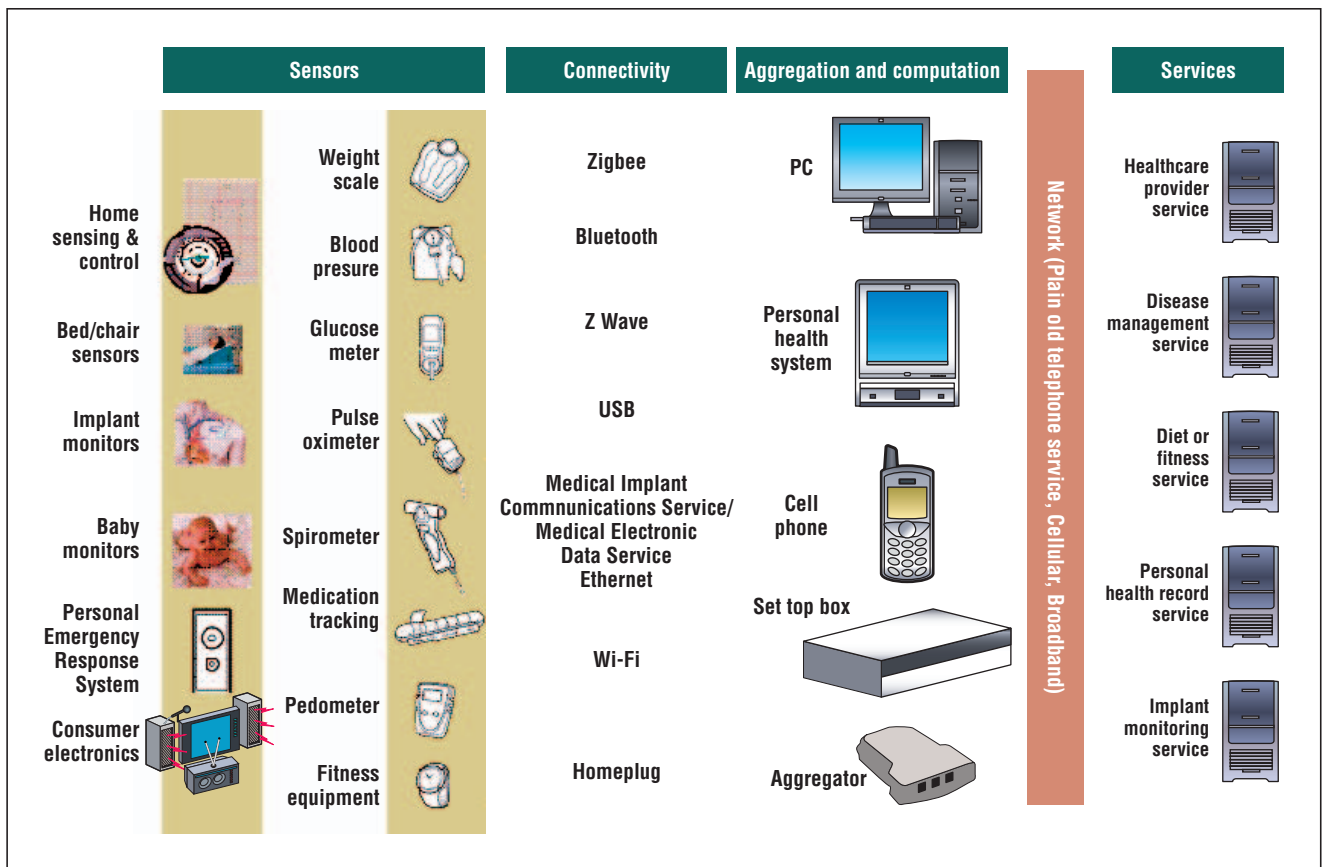


Figure 1. A typical personal telehealth ecosystem.

viders. It's also facilitating government and insurance reimbursement discussions to ensure that the economics of the system work for all concerned.

THE REFERENCE ARCHITECTURE

The Continua End-to-End (E2E) Reference Architecture gives a high-level architectural view of the Continua ecosystem, including its topology constraints (see figure 2). The distributed-systems architecture breaks down its functionality into five reference-device classes and four network interfaces that connect the devices to a reference topology. The network interfaces are at the center of Continua's interoperability goals and are the crux of the test and certification targets for candidate devices.

The Peripheral Area Network Interface (PAN-IF) connects an application-hosting device, such as a personal com-

puter, cell phone, or monitoring hub, to a PAN device, which is either a sensor or an actuator. (A sensor might be a glucose meter, weight scale, pedometer, heart-rate monitor, or carbon monoxide detector. The actuator could be a device that can turn on or off a light, shut off the gas in an emergency, output text, or set off an alarm.) The PAN-IF has both a lower-layers component (encompassing the classic open-systems-interconnection layers 1-4) and an upper-layers component (encompassing the classic OSI layers 5-7).

Example instantiations of the PAN-IF lower layers include both wired and wireless links (such as USB- and Bluetooth-based technologies). The PAN-IF upper layers are implemented using the ISO/IEEE 11073-20601 Optimized Exchange Protocol, which leverages work from the ISO/IEEE 11073 Medical Device Communications working group.

The Local Area Network Interface

(LAN-IF) connects an application-hosting device to a LAN device. This device aggregates and shares (though a network) the bound PAN devices' information (this is often referred to as a proxy function). A LAN device can also implement sensor and actuator functionality directly. This means that the LAN-IF upper layers can support the same device data model as the PAN-IF upper layers (that is, the ISO/IEEE 11073-20601 data model). Using the same device data model, regardless of the underlying lower-layers communications mechanism, is a key interoperability feature. Continua aims to base the LAN-IF lower layers on Internet Protocol technology to enable different IP-centric communications technologies (such as Ethernet and Wi-Fi technologies).

The Wide Area Network Interface (WAN-IF) connects an application-hosting device to one or more WAN

HEALTHCARE NEEDS

Acute diseases and conditions are often treatable owing to the advancement of healthcare techniques. People are now living longer, so we're seeing a corresponding rise in chronic diseases:

- Over 600 million people worldwide have chronic diseases.¹
- According to the American Diabetes Association, in the US alone, 20.8 million children and adults—7.0 percent of the population—have diabetes (see www.diabetes.org/about-diabetes.jsp). An additional 54 million people have prediabetes (see www.diabetes.org/pre-diabetes.jsp).
- Spending on chronic diseases is expected to increase from \$500 billion a year to \$685 billion by 2020.¹

Therefore, we need to exploit technological advances to reduce costs and improve quality of life.

Furthermore, with the Baby Boomer generation, we have an aging population that requires escalating levels of assistance and medical intervention:

- Globally, the number of people age 60 and older was 600 million in the year 2000.²
- By 2020, the over-65 population will double; it will triple by 2050.³
- By 2020, the shortage of registered nurses required could reach 1 million.⁴

So, we need to enable the elderly to live independently as long as possible (aging in place), with the peace of mind that assistance from their caregiver group (family, friends, neighbors, and professionals) is in reach when needed.

Another pressing healthcare issue relates to obesity and physical inactivity:

- More than 1 billion people in the world are overweight, and at least 300 million of those are clinically obese.⁵
- Every year, more than 2 million deaths worldwide are attributable to physical inactivity. (See www.stirlingmedical.com/education/statistics.)
- In 2005, the World Health Organization reported that it expects more than 2.3 billion to be overweight by 2015 (see www.who.int/mediacentre/factsheets/fs311/en).

We need to prevent future health risks by engaging citizens in a healthy and balanced lifestyle through challenging self-health management and fitness solutions.

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devices. A typical WAN device implements a managed-network-based service. It collects information and hosts a wide range of value-adding services (for example, a health- or fitness-monitoring service hosted on a network-based server). The WAN-IF upper layers use a device data model that's compatible with the LAN-IF upper layers' device data model. Continua also plans to base the WAN-IF lower layers on IP technology to enable IP-centric communications technologies (such as xDSL, Docsis [Data over Cable Service Interface Specifications], PPP/POTS [Point-to-Point Protocol/Plain old telephone service], GPRS [General Packet Radio Service], and

EDGE [Enhanced Data Rates for GSM Evolution]). Again, the sharable, exchangeable device data model is the key component of the interoperable Continua ecosystem.

The Electronic/Personal Health Records Network Interface (xHRN-IF) enables patient-centric data communications between a WAN device and a health-record device, typically at the boundary of the personal telehealth ecosystem. This is in contrast to the other interfaces, which support device-centric data communications between an application-hosting device and other Continua devices. The typical xHRN device implements a health-record database or other system, man-

aged and operated by a traditional healthcare service provider. (For example, an electronic-health-records system that a hospital or healthcare system manages and operates). The xHRN-IF lets multiple enterprise healthcare entities exchange personal health information. The corresponding health-record systems have existing industry-standard information models that likely differ from the Continua WAN device. This interface describes how healthcare entities can transform the data so that all parts of the larger healthcare systems can collaborate.

All of these Continua interfaces will have associated guideline specifications and test suites. However, especially in

the short term, Continua can't encompass all the communications interfaces that various vendors bring to the market using existing or emerging proprietary or open technologies. So, we recognize that noncertified interfaces will exist in the personal telehealth ecosystem that aren't part of the Continua reference architecture. However, the architecture will be able to bridge devices with noncertified interfaces to the Continua ecosystem using a PAN adapter device or a LAN sharing device (see the composite devices examples in figure 2). For example, an RF-receiver dongle paired via a proprietary wireless communications technology to a health watch may, as a set, be certified as a Continua PAN device. The architecture can then plug that device into Continua application-hosting devices.

THE BIG PICTURE

To facilitate this large-scale operation, Continua has created a series of working groups, all governed by a board of directors. These groups pursue independent subgoals and tasks and periodically report to the larger Continua organization. The Technical Working Group has organized its work into numerous subgroups, including one for each of the four interoperable interfaces and one for each of the three focus areas. It also has subgroups that focus on some overarching subject, such as the overall architecture or system security and privacy.

Much of the work is restricted to Continua's members. However, another way to participate is to join the corresponding SDOs, which also lets you fully participate in the discussion and construction of the bedrock standards (for example, see the "PAN Interface Standards" sidebar).

Continua plans to complete its Version One Guidelines in the first quarter of 2008. At the same time, it will launch its certification and testing program. These guidelines, tests, and procedures will ensure interoper-

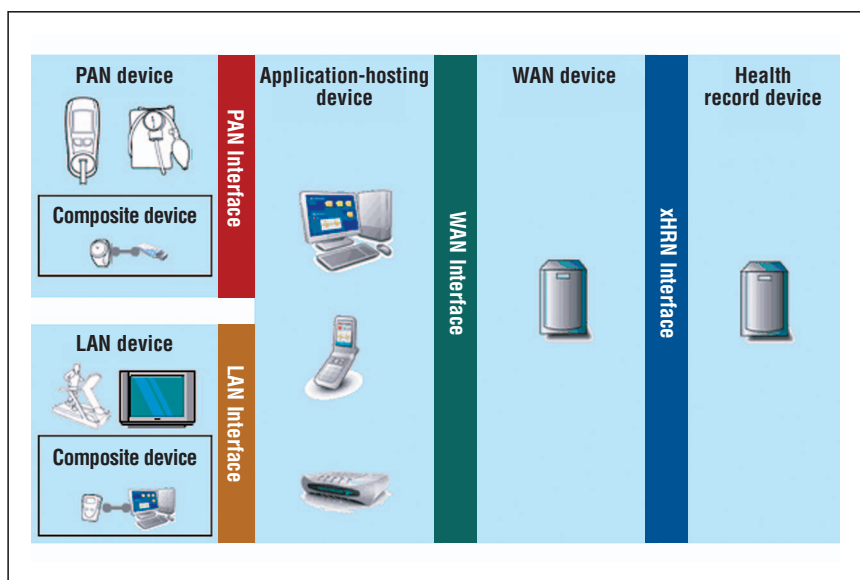


Figure 2. The Continua End-to-End reference architecture.

PAN INTERFACE STANDARDS

Here are a few Peripheral Area Network Interface standards-development activities that are underway.

Data and protocol

The ISO/IEEE 11073 Personal Health Data Working Group is defining transport-independent personal-health data and protocol standards. The group's charter is to provide standards that address transport-independent application and information profiles between PAN devices and application-hosting devices. Application and information profiles comprise exchange format, data representation, and terminology. The common exchange format should let different domains share data. For more information, contact the group chair at phd-chair@ieee.org.

Wireless transport

The Bluetooth SIG Medical Devices Working Group is tasked with enabling interoperability between Bluetooth-enabled medical, health, and fitness devices, and systems that can aggregate and perform operations on device data. (Such data could be from cellular phones, health appliances, set-top boxes, or PCs.) This effort includes the development of a profile that allows consumers to easily connect any two devices that support the medical device profile. Such devices have unique needs, and this working group aims to address those needs through focused representation of the medical- and fitness-device industries. For more information, contact the group chair at med-chair@bluetooth.org.

Wired transport

The USB-IF Personal Healthcare Device Working Group is tasked to enable personal healthcare devices to seamlessly interoperate with USB hosts. The group's initial goal is to define a USB Personal Healthcare Device Class specification. The specification will enable health-related devices, such as blood pressure cuffs and exercise watches, to connect via USB to consumer electronic products such as PCs and health appliances. Interoperability of health-related devices and consumer electronic products will facilitate the communication between a patient and a doctor, an individual and a fitness coach, or an elderly person and a remote caregiver. For more information, contact the group chair at personal_healthcare_chair@usb.org.

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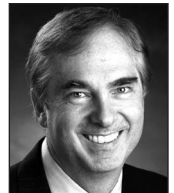


ability of the components within the personal healthcare ecosystem. This paves the way for new and innovative products to radically improve health and quality of life as well as eliminate unnecessary costs from the healthcare system. 

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