

# Home Health Gateway based on the Intel® Atom Processor

Gateway demo illustrates how to address design challenges and satisfy key end user requirements



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*Paul Otellini,  
President and CEO  
Intel Corporation*

People are living longer, and the global population is aging, prompting the healthcare industry to consider new ways to extend care to the home and other residential settings. "We must rethink models of care that go beyond hospital and clinic visits, to home and community-based care models that allow for prevention, early detection, behavior change and social support," says Paul Otellini, Intel President and CEO.<sup>1</sup> One promising delivery model is based around telehealth, which creates an opportunity to reduce costs while giving patients more control over their own care in a convenient fashion. A key component of a telehealth solution is the home health gateway, an in-home patient device that allows clinicians to monitor patients and provide care remotely.

Healthcare solution providers can dramatically decrease the time required to design a home health gateway by leveraging an off-the-shelf gateway platform available from Avalue Technology\*. Based on the Intel® Atom™ Processor N270, this platform addresses many of the hardware design challenges facing equipment manufacturers, and at the same time satisfies key patient requirements. Foremost, the platform

enables system designers to develop engaging and secure systems that maximize device interoperability and support an upgrade path for the future. The capabilities of the platform facilitate a device that is easy-to-use, makes two-way video calls, accesses medical data and information, and protects patient privacy. This paper describes a demo of a home health gateway that was developed by the embedded medical team at Intel to show how embedded Intel® architecture processors address the aforementioned design challenges and end user requirements.

## Telehealth Infrastructure

Telehealth uses information and communication technology (ICT) to deliver health services and information to patients outside of clinical settings, typically to the home. Using a home health gateway connected to monitoring devices, as shown on the left side of Figure 1, patients can take an active role in their healthcare. These telehealth systems promote greater patient engagement and more efficient care by combining an in-home patient device with an online interface, allowing clinicians to remotely monitor and care for patients.

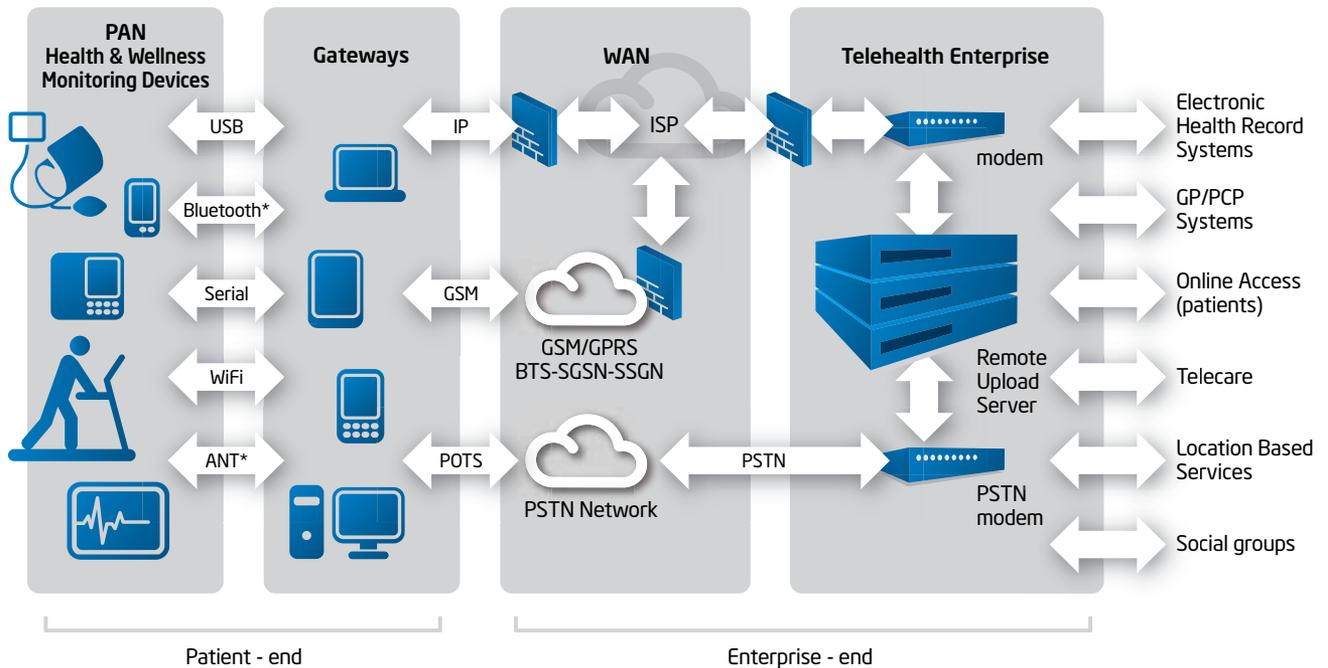


Figure 1. Telehealth Infrastructure

Telehealth systems enable patients to:

- Take vital sign measurements as defined in their care plan
- Monitor their health status under the guidance of a healthcare professional
- Meet with healthcare providers using video conferencing
- Access educational content to learn more about their health condition
- Get reminders: go to medical appointment, take medication, measure vital signs

The wide area network (WAN) portion of the telehealth infrastructure (Figure 1) supports various types of communication services, including the Internet via the Internet Protocol (IP), mobile broadband (e.g., GSM), and landlines providing plain old telephone service (POTS). The WAN supports healthcare service providers through the public switched telephone network (PSTN) or Internet connections.

### Gateway Design Challenges

With the emergence of telehealth, medical equipment manufacturers face the challenge of developing home health gateways, a consumer-oriented product that must appeal to the masses. Complicating matters, the telehealth service model is still in its infancy, which means product requirements haven't been fully ironed out and designs must be nimble. For devices installed today, it's still unclear what they could be expected to do in the next few years.

One of the key challenges for gateway designers, listed in Table 1, is keeping

patients engaged so they don't put the device aside and forget about it. Since a home health gateway is primarily for seniors and elderly patients suffering from chronic illnesses, it should have a simple, yet attractive, user interface.

Under the cover, the gateway must protect patient data and communications, and support a wide range of telehealth peripherals in Plug and Play fashion. To keep up with evolving and innovative new services, the gateway platform should be upgradeability with minimal engineering effort.

Manufacturers' Challenges	Goals
Keep users engaged	Support compelling applications and a simple, attractive user interface with a modern look-and-feel
Protect patient data and communications	Design in comprehensive, end-to-end security between patients and healthcare providers
Maximize gateway interoperability	Ensure home health gateway communicates with a wide range of telehealth peripherals over a variety of transport technologies (e.g., serial, Bluetooth*, ZigBee*)
Provide upgrade path	Allow users to add new applications/features to existing gateways, and ensure the design scales with minimal engineering rework

Table 1: Equipment Manufacturers' Challenges

## End User Requirements

Although a PC or laptop could be the basis for a home health gateway, many end users are looking for a less complicated device. They want to simply press a button on a touchscreen to start an application and not be bothered with the device booting, security updates or the diversity of a modern PC. Users also want to have video conferences with their healthcare providers, ready access to medical information and confidence their privacy is protected, as described in Table 2.

End User Requirements	Drivers
Easy-to-use	Aging and chronically ill patients shun complex electronic products
Two-way video calls	Health care providers can view their patients performing specific tasks and more effectively offer advice/encouragement
Informative	Many patients want to take an active role in their care, reviewing their medical data and learning more about their condition and treatment options
Privacy	Users want assurance their identities and personal records are fully protected

Table 2: Key End User Requirements



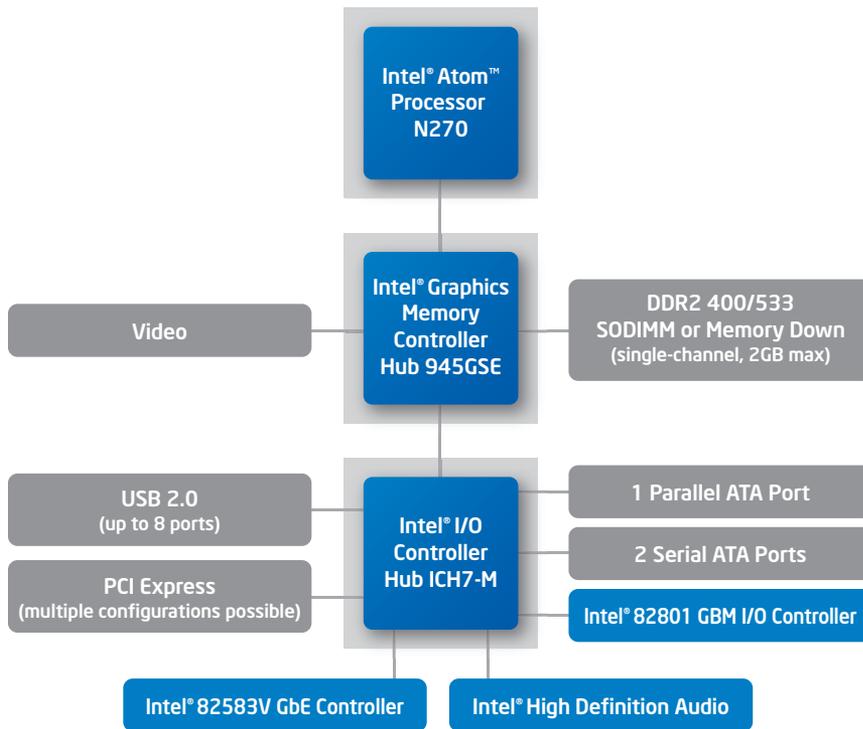


Figure 2. Intel® Atom™ Processor N270 Platform Diagram

## Gateway Platform

Code-compatible Intel architecture processors enable medical equipment manufacturers to cost-effectively develop a family of devices, selecting the right processor to reach specific price-performance and size targets. Intel® processor-based platforms are also standards-based, which greatly simplifies the task of integrating the latest networking, communications, wireless and security technologies. When developing a low cost home health gateway, the Intel® Atom™ processor is a good fit for the job.

Engineers at Intel developed a gateway demo based on the platform illustrated in Figure 2. It supports a variety of health and vital signs monitoring devices connected via personal area network (PAN) interfaces including Bluetooth\*, Bluetooth Low Energy (LE), ANT\*, ZigBee\* and WiFi. The associated radios are connected to PCI Express\* links on the platform. The Intel home health gateway demo illustrates how this platform meets key design challenges, including:

- **Engaging:** Gateway platforms based on the Intel Atom processor have the computing and high definition (HD) graphics performance needed for demanding two way video conferencing and rendering educational videos and animation. This comprehensive platform, combined with industry-leading software development tools, enables developers to create a captivating device that supports innovative, compelling applications.
- **Secure:** Patient data and information can be stored in a highly encrypted format as well as by securing the data during transmission (via SSL) to a remote database. Data may be further protected by allowing only secure (HTTPS, 128-bit SSL) access to the web tools and securing all data during transmission to and from a patient. Encryption and security protocols are compute-intensive and can be handled by the Intel Atom processor, which typically has more processing headroom than other low power processors on the market.

- **Interoperable:** The platform can run software that satisfies standards defined by Continua\*, which is dedicated to establishing a system of interoperable personal health solutions.
- **Upgradeable:** The Intel Atom processor family is continually improved through predictable architectural and manufacturing advances, called the Intel “Tick-Tock” model, which yields a product roadmap providing more power-efficient performance and higher levels of integration.

Likewise, the demo shows how an Intel Atom processor-based platform can be used to satisfy key user requirements, such as:

**Easy-to-use:** The platform integrates a 3D graphics engine that delivers exceptional video performance and supports a straightforward, contemporary user interface.

**Two-way video calls:** Integrated graphics and audio capabilities enhance the patient’s video call experience.

**Informative:** The same technology PC users rely on to surf the Internet and conduct confidential business (e.g., bank transactions) is built into the platform.

**Privacy:** The platform can run the most advanced security mechanisms, including SSL and PSK.

## Discussion of demo functions

This section reviews some of the functionality and use models of the Intel home health gateway demo. The demo has two software loads, one running on the healthcare provider’s PC and another running on the home health gateway. The following shows a healthcare provider making a call to a patient, the patient answering the call, the healthcare provider reviewing medical information, and the patient taking a blood pressure measurement.



### REVIEW AVALUE\* TECHNOLOGY'S N270 BOARD

The Intel home health gateway demo runs on a commercially available board from Avalue Technology Inc., an affiliate member of the Intel® Embedded Alliance, a community of embedded developers and solution providers. The EPIC module, called the EPI-945GSE Express Chipset, has an Intel® Atom™ processor N270 and the mobile Intel® 945GSE Express chipset. The board supports dual-channel LVDS, DVI and the Intel® High Definition Audio interface, along with SATA, USB and GPIO, among other features.

For more information about the EPI-945GSE board from Avalue Technology, please visit [www.avalue.com.tw/products/EPI-945GSE.cfm](http://www.avalue.com.tw/products/EPI-945GSE.cfm)

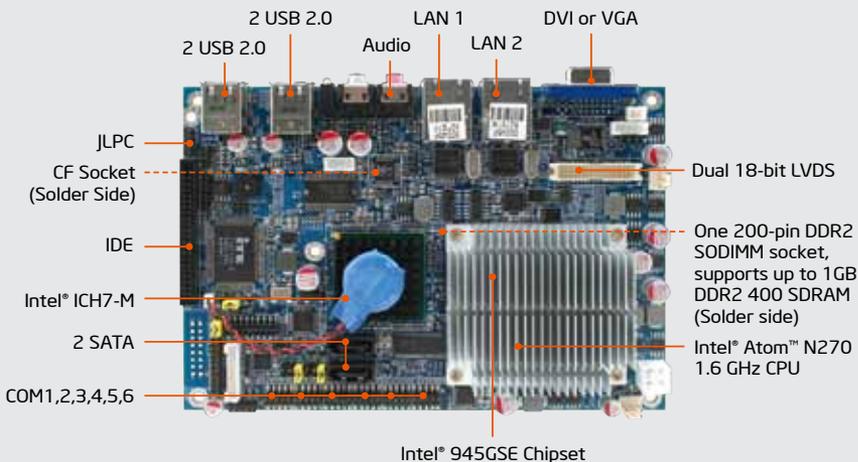


Figure 3. EPI-945GSE board from Avalue Technology\*



### Healthcare Provider Makes a Call

The telehealth application runs on the healthcare provider's PC and supports various activities, such as receiving messages, calling patients and colleagues, modifying patient information, reviewing medicinal information and scheduling appointments. In this case, the healthcare provider initiates a video conference by selecting a patient from a contact list.



Figure 4. Patient Contact List

### Patient Answers and Validates the Call

Anticipating a call from his/her healthcare provider, the patient answers the call, which activates bi-directional video streams. The healthcare provider sees the patient in a video window and the patient's static image and medical information in the upper right corner of the screen.

The patient must validate the call, and this is done by scanning his/her identification card (ID) using the bar code card reader on the gateway. This ID card is one of the ways the telehealth system protects the privacy of the patient.

### Patient Measures Blood Pressure

The home health gateway supports various wired and wireless telehealth peripherals. The patient can attach a blood pressure cuff to the gateway and measure his/her blood pressure by following the instructions in the popup menu. If this is the first time the patient is using the blood pressure cuff, the healthcare provider can watch the patient and offer instruction, as needed.

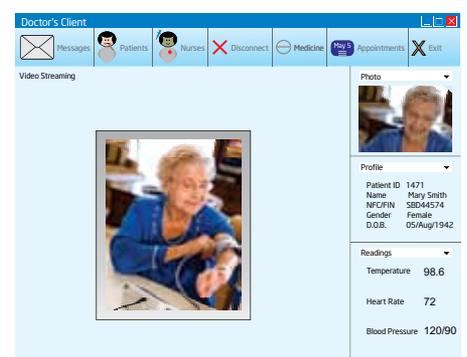


Figure 5. Patient Take Blood Pressure Measurement



Figure 6. Blood Pressure Measurement



Figure 7. Medicinal Information

### Healthcare Provider Reviews Medications

After a patient scans his/her medicine bottles using the gateway's bar code reader, the healthcare provider can pull up and review information about the patient's medication by selecting the Medicine icon.

When the call is finished, the patient and healthcare provider hit their disconnect buttons to end the session.

### Connecting Patients and Healthcare Providers

Saving time and enjoying the convenience, people are doing more remotely, like banking, shopping, studying and working. Similarly, telehealth promises to offer more efficient care by connecting patients and healthcare providers using the Internet and phone lines. Much of the

necessary infrastructure is already in place, with the exception of home health gateway devices.

Although a gateway could be easily implemented on a standard PC, the user experience is perhaps better served by a straightforward, dedicated product. This can be achieved with the Intel Atom processor that can fit into a small, low power device that is easy to use for seniors and the chronically ill. An Intel Atom processor-based platform provides all the functionality needed for a gateway, as shown by the home health gateway demo developed by Intel.



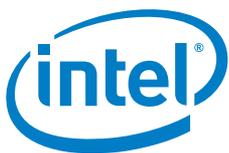
#### **BENEFITS OF USING INTEL® ATOM™ PROCESSORS**

Medical equipment manufacturers can reduce development effort and time with Intel® Atom™ processor-based platforms that already address most of the home health gateway requirements:

- **Low power** - processor plus chipset as low as 6 watts
- **User interface** - exceptional development tools
- **Secure communications** - industry standards supported
- **Exceptional video quality** - integrated graphics engine
- **Highly interoperable** - Continua\* supported
- **Code portability** - backward-compatible processor family

#### **Learn More**

For more information about Intel Healthcare solutions, please visit [www.intel.com/go/medical](http://www.intel.com/go/medical)



<sup>1</sup> Source: [http://www.intel.com/pressroom/archive/releases/2010/20100802corp\\_sm.htm#story](http://www.intel.com/pressroom/archive/releases/2010/20100802corp_sm.htm#story)

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