

Continua Health Alliance: Architectural Overview & Comparison with 2009 Phoenix Architecture

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Phoenix Project

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1

Table of Contents

- Phoenix Background
 - Vision & Mission
 - Architectural Requirements
 - Architectural Model 2009
- Continua Health Alliance
 - Vision & Mission
 - Use Cases
 - Architectural Model
 - Current “Eco-System”
- Conclusions

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2

Phoenix Vision

- Measurement
 - Blood pressure
 - Heart rate
- Repetitive
- Around-the-clock
- Week or longer
- Analysis tools
 - Self care
 - Diagnosis
 - Prevention & Pre-habilitation
 - Treatment & Re-habilitation
- Long term
- Massive scale

12 September 2010 3

Repetitive -- automatic, periodic measurement

Around-the-clock -- regardless of person's activity

Week or longer -- initially, collect at least one week of data per session

Long term -- data for an individual may span the individual's life

Massive scale

From current load of hundreds of sessions per year

To millions of sessions per year

Project Mission

- Develop ambulatory blood pressure monitor
 - Inexpensive
 - Unobtrusive
 - Easy to use
 - Collects a week of blood pressure measurements
- Develop software
 - Chronobiological analysis of collected blood pressure measurements

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4

Inexpensive

- Price not a barrier to use
- Less expensive than blood pressure cuff
- Comparably priced to other personal accessories (less expensive than wrist watch; < US\$50)
- Globally affordable (less expensive than “two bushels of yams”; < US\$10)

Unobtrusive

- When wearing monitor, patient can
 - Forget about, be unaware of device
 - No more encumbering than wrist watch, Band-aid™, piece of jewelry
- Usable wherever the patient is
 - At home, at work
 - Not only in clinical setting

Easy to use

- Easier to use than current BP cuffs, home BP monitors
- Patient can:
 - Ignore device
 - Determine that device is functioning normally
 - Observe a blood pressure and heart rate measurement
- Device is automatic -- takes measurements regardless of patient behavior
- Allows manually initiated measurements

Architectural Requirements

- Inexpensive
 - Open source
 - Free intellectual property, volunteer labor
- Highly decomposed
 - Consequence of open source
 - Each component quickly engineered by very small team (usually one person)
- Extensible -- highly recomposable
 - Consequence of multiple actors, vaguely organized
 - Evolving user classes, usage scenarios, environments
 - Highly re-usable components

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5

Architectural Requirements

- Scalable
 - Ready to cope with volume increases
 - Wearers
 - Acquired data
 - Analysis requests
- Security & Privacy
 - Principles:
 - Wearer owns measurements of the wearer's body
 - Caregivers are custodians
 - Control belongs to the wearer
 - Manage person (patient) identity externally

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6

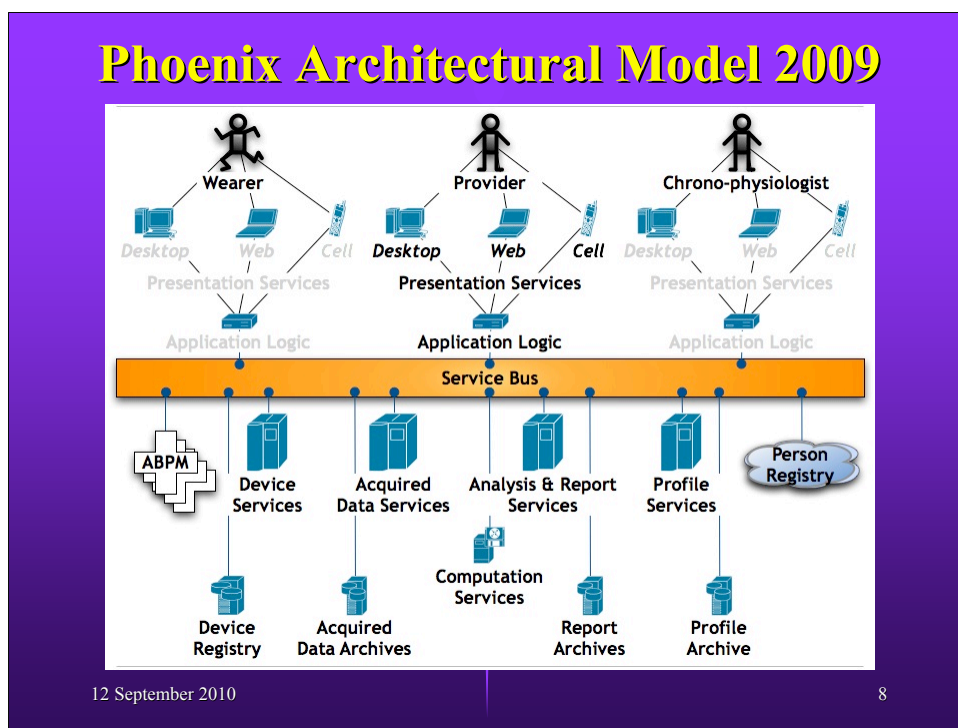
NOTE: Project has not yet investigated security issues

Phoenix 2009 Architectural Layers

- Actors
- Applications
- Presentation Services
- Data Acquisition
- Modeling and Profiling
- Person Identity Management
- Analysis and Reporting
- Service Bus

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7



Two compatible architectural styles:

1. Service Oriented Architecture (SOA) -- loosely coupled, distributed computing
2. Cloud computing -- internet-based computing, with shared resources available on-demand

Advantage: promotes decomposition and recomposition

Disadvantage: ABPM as a service seems a stretch



Continua Health Alliance: The Next Generation of Personal Telehealth is Here

A non-profit, open industry alliance of the finest healthcare and technology companies in the world joining together in collaboration to improve the quality of personal healthcare.

Objective of
Continua (telehealth)
is broader than that of
Phoenix (ABPM with chronobiological services)

All slides taken from
http://www.continuaalliance.org/static/cms_workspace/Continua_Overview_Presentation_v19.4.pdf

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 Continua
HEALTH ALLIANCE

Continua Health Alliance



“Our Mission is to establish an eco-system of interoperable personal health systems that empower people & organizations to better manage their health and wellness”

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10

 **The Continuum of Care**

CONTINUUM of LIFE

Infant Amateur Athlete Diet/Fitness Focused Worried Well Chronic Patient Acute Recovery Elderly Living Independently

Continua Health Alliance enables a personal health eco-system that empowers individuals & families to better manage their own health and wellness across the continuum of life and care methods.

CONTINUUM of CARE GIVERS

New Parents Fitness Wellness Coach The Family Home Nursing Professional Doctor/NP/Nurse

7/19/2010 3

High degree of alignment with Phoenix

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11

 **The Challenge & The Opportunity**

- Worldwide today:
 - 1 billion adults overweight
 - 860 million chronic disease patients
 - 600 million elders age 60 or older



- 75-85% of healthcare spending is on chronic disease management

Source: World Health Organization, McKinsey

Consistent with,
though broader than, Phoenix

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Additional Phoenix challenge: broaden chronomedicine beyond its current scope of sleep therapy

Continua Use Cases

<http://www.continuaalliance.org/connected-health-vision/aging-independently.html>


<http://www.continuaalliance.org/connected-health-vision/health-and-wellness.html>



<http://www.continuaalliance.org/connected-health-vision/disease-management.html>


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13

 **Continua**
HEALTH & WELLNESS

Health and Wellness

One billion adults overweight world wide



Healthy Family


"Worried well" vital sign monitoring:

- Weight
- Blood pressure
- Glucose
- Cholesterol
- Activity level

Benefits:

- Monitor and motivate
- Achieve individuals' goals
- Access personal fitness information anywhere
- Enhance trainers' services


Continua member companies help people live healthier, more active lives by connecting them to their health and wellness team through a more efficient exchange of their personal fitness information.



The diagram illustrates a 'Digital Home' ecosystem. A central house icon contains a 'Cell Phone' and a 'PC'. To the left, a vertical stack of health-related icons is connected to the house: 'Blood-pressure Cuff', 'Heart Strap', 'Pedometer', 'Weight Scale', 'Fitness Equipment', and 'Medication Tracking'. To the right, an 'Internet' connection leads to a box containing three services: 'Weight loss and fitness coaching', 'Healthcare Professionals', and 'Personal Health Record'. A text box above this right-side box states: 'Continua member companies help people live healthier, more active lives by connecting them to their health and wellness team through a more efficient exchange of their personal fitness information.'


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14



Disease Management

860 million chronic disease patients world wide



**Vital sign monitoring:
(remote patient monitoring)**

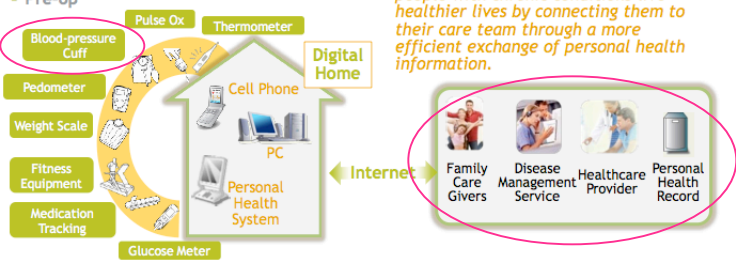
- Diabetes
- COPD
- CHF
- Hypertension

Benefits:

- Provide better-coordinated care
- Connect to care team
- Empower individuals
- Encourage early detection
- Reduce costs

- Chronic disease
- Post trauma
- Pre-op

Continua member companies help people with chronic conditions live healthier lives by connecting them to their care team through a more efficient exchange of personal health information.



The diagram illustrates a 'Digital Home' concept. A central box labeled 'Personal Health System' contains a 'PC' and a 'Cell Phone'. Surrounding this central box are various health-related devices: 'Pulse Ox', 'Thermometer', 'Blood-pressure Cuff', 'Pedometer', 'Weight Scale', 'Fitness Equipment', 'Medication Tracking', and 'Glucose Meter'. These devices are connected to the central system via a large orange arrow. To the right, a box labeled 'Digital Home' contains icons for 'Family Care Givers', 'Disease Management Service', 'Healthcare Provider', and 'Personal Health Record'. A double-headed arrow labeled 'Internet' connects the 'Personal Health System' to the 'Digital Home' box.

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15

 **Continua**
HEALTH & WELLNESS

Aging Independently

600 million elderly individuals world wide



- Independent living
- Chronic disease

Basic life monitoring:

- Bed pressure (sleep)
- Bathroom sensor
- Gas / water sensor
- Emergency sensor

Benefits:

- Involve family members
- Allow remote analysis & care
- Provide integrated view
- Encourage early detection
- Reduce costs

Continua member companies help the elderly age independently, with dignity and security, through the efficient exchange of personal health and safety information that connects them to their family and care team.



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16

 **Continua**
HEALTH ALLIANCE

Guidelines → Certification → Recognizable Logo


Guidelines

Continua member companies will select connectivity standards and publish Guidelines for strict interoperability.

Certification and Logo

Continua is establishing a test and certification program with a recognizable logo signifying the promise of interoperability with other certified products.


Electronic Media / Software



Product Packaging



Product Applications

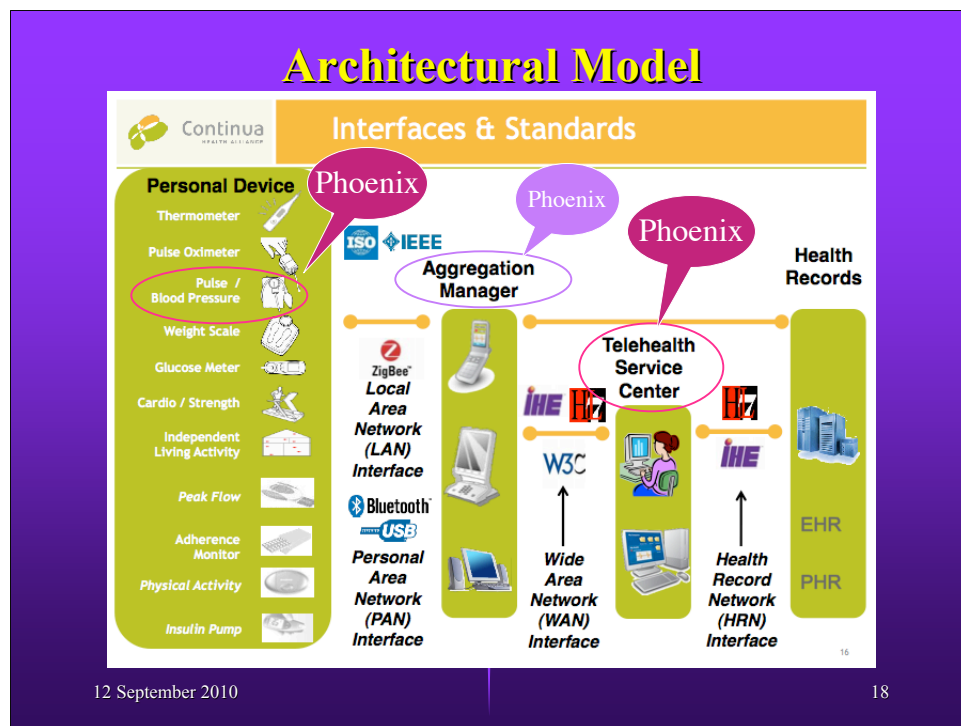


Product Substrates



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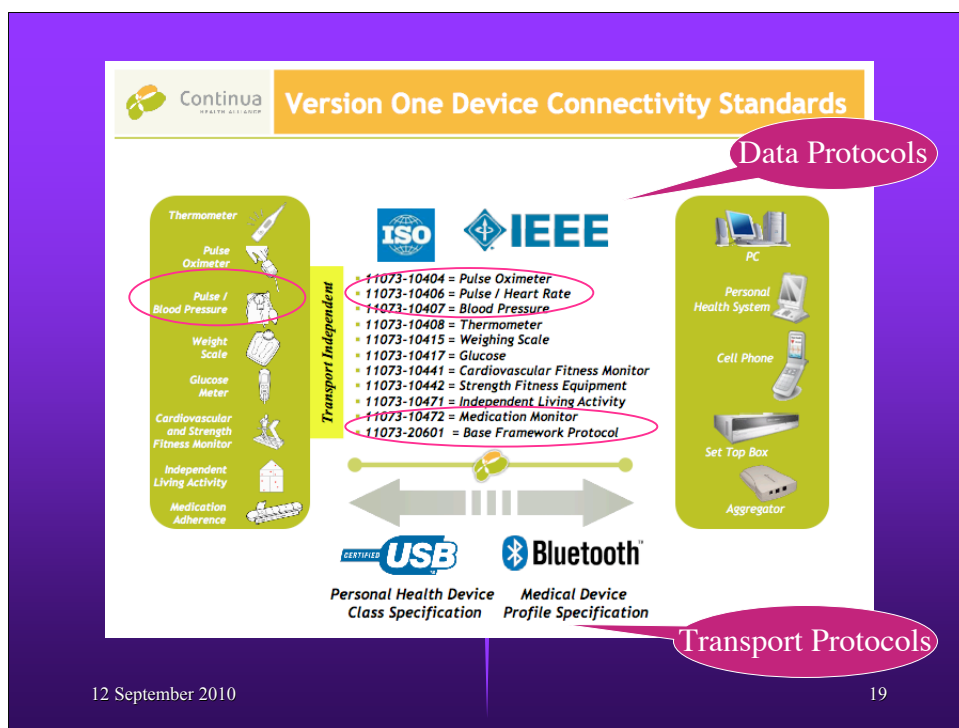
17

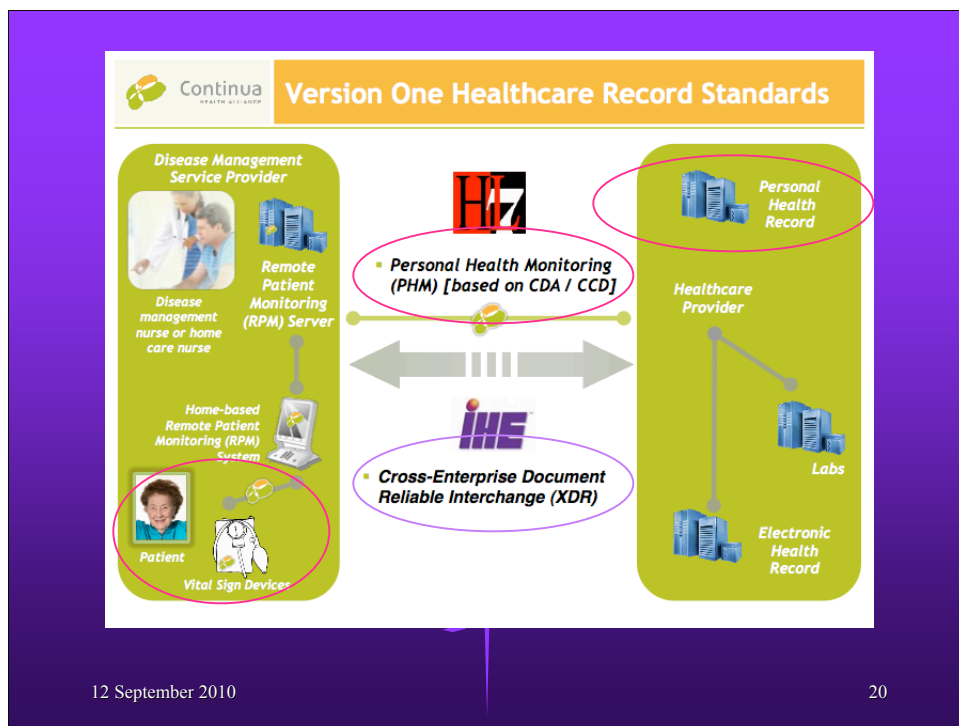


ZigBee -- wireless protocol based on IEEE 802.15.4, which is longer range than Bluetooth. Low power consumption. Designed for device interconnection.


“ZigBee was created to address the market need for a cost-effective, standards-based wireless networking solution that supports low data-rates, low-power consumption, security, and reliability.

“ZigBee is the only standards-based technology that addresses the unique needs of most remote monitoring and control and sensory network applications.”





Current Eco-System

 **Free Reference Source Code** Save \$800K on Product Development!

Source Code Library

- 500 modules of member-written source code already available in our library...downloaded by dozens of companies
- We are paying contractors to write the rest. Currently investing over \$800k...will add more code to the library each year
- Structured as library of modules w/ API
- Reference code only—use at your own risk (disclaimer)

Generic Reference Platform

- Operating system: Windows XP
- Hardware: X86-based
- Language: Object Oriented C++ | C for embedded components

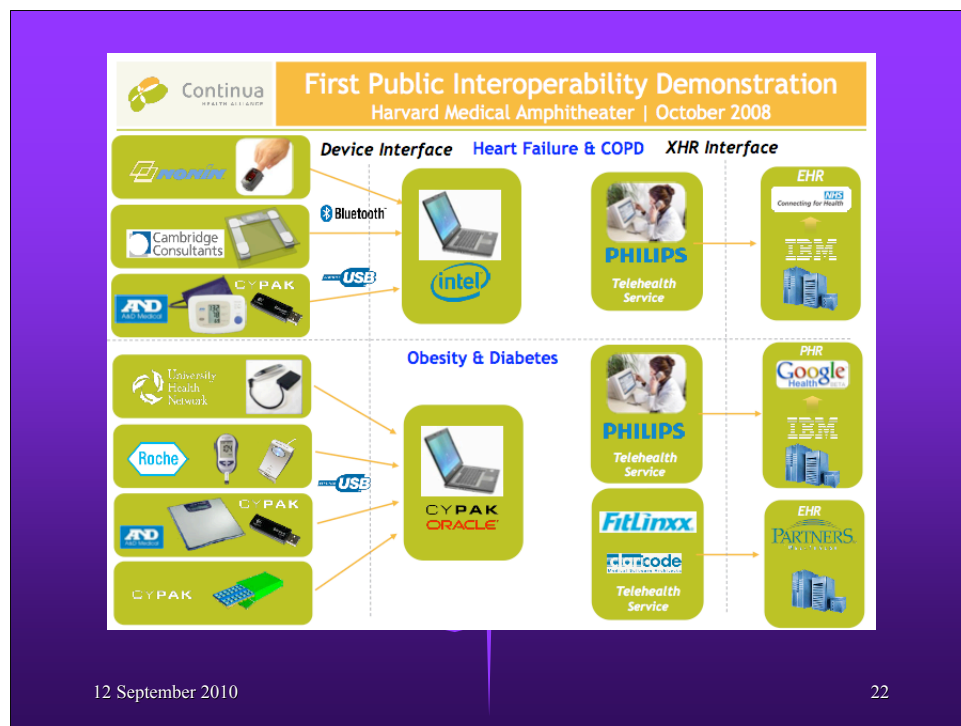
Implement Mandatory Features of Guidelines

- Common Source for Certification Test Tool, Plugfest System Simulator, Member Implementations

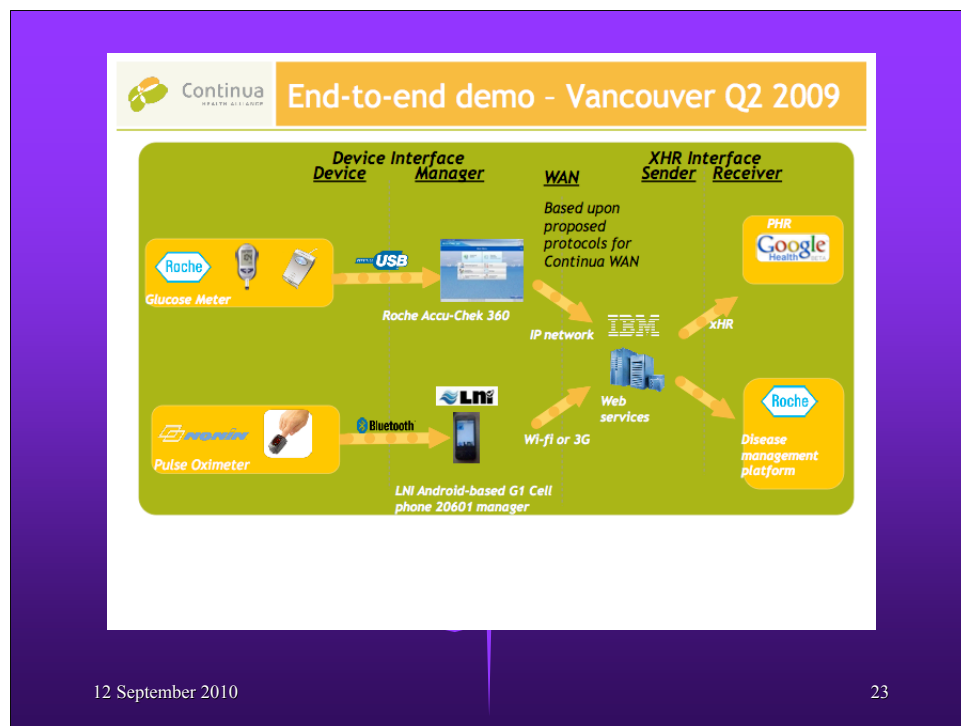
12 September 201021

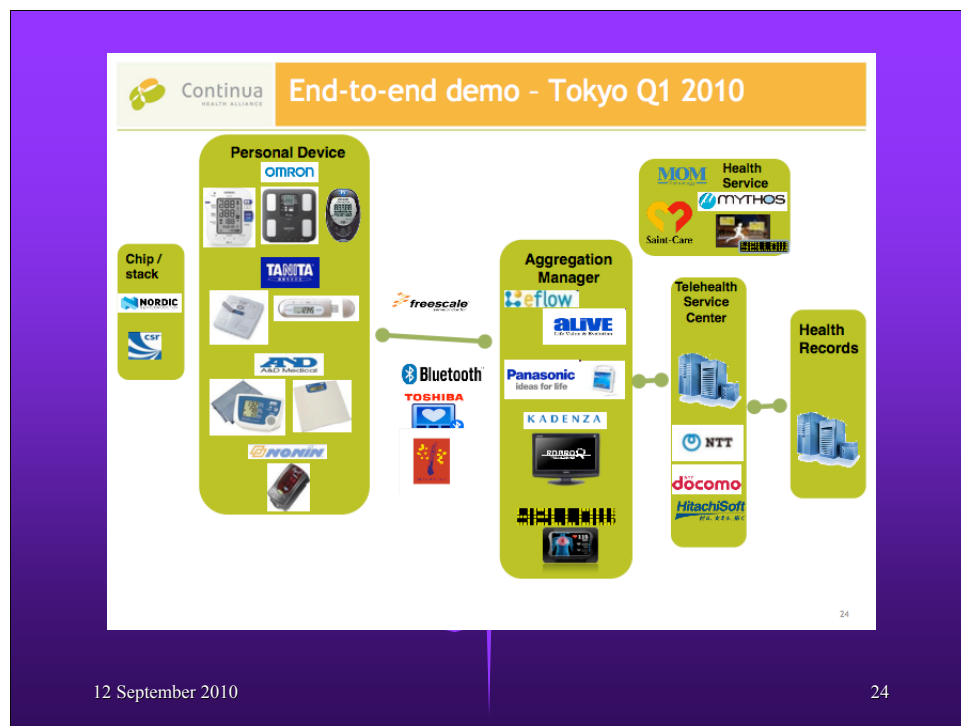
The source code is “free” with annual membership: \$6500

External design guidelines alone: “free” with membership, \$500 without



COPD = chronic obstructive pulmonary disease (e.g., asthma, chronic bronchitis, pulmonary emphysema)





Continua
HEALTH ALLIANCE

Latest Continua Certified™ Products

Panasonic
ideas for life
Panasonic TOUGHBOOK H1 with Blood Pressure Monitor, Cardiovascular and Weighing Scale device specializations by Bluetooth

TEXAS INSTRUMENTS
Texas Instruments MSP430 USB Agent Platform

A&D Medical
A&D Blood Pressure Monitor w/ CPX186 Converter Cable
A&D Weight Scale w/ CYPAK Converter Cable
A&D Medical Blood Pressure Monitor
A&D Medical Weight Scale

TOSHIBA
Continua Bluetooth Manager Stack for Windows, manufactured by Toshiba

OMRON
Omron Continua Certified Weighing Scale with a Body Composition Monitor
Omron Pedometer
Omron Blood Pressure Monitor

Roche
Roche Accu-Chek® Smart Pix Device Reader

Nonin
Nonin Pulse Oximeter
Nonin Wireless Fingertip Pulse Oximeter

Continua
CERTIFIED

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25

Conclusions

- Continua sufficiently supported by industry to justify Phoenix's adoption of Continua standards
 - Would improve chance of industry adoption of Phoenix
- Cost of membership is prohibitive to Phoenix
- Concerned that Continua license would infringe on Phoenix mission and license
 - Further investigation needed
- Phoenix should investigate IEEE Standard 11703
 - Either adopt in parallel to Continua, or
 - Build wrappers within which 11703-compliant software/firmware could be later placed

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26