Enabling Healthcare Service Delivery and Management

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Agenda

- Background
- The Vision
- Issues and Challenges
  - Quality of Service
  - Common capabilities
  - Security
- Potential Solutions
  - Related work
- Summary
Background

Remote/In-Home and mobile wireless medical monitoring are

– Growing trends in healthcare
– Important enabling technologies for aging care, for reducing healthcare costs, and promoting self-care
The Vision
End-to-end sensor-based service delivery and management architecture for the deployment of extended healthcare services

- Video conferencing
- Medical devices
- Networked household devices
- Service platform
- Service gateway
- Network-based server
- Central monitoring service
- Service provider
- Family
- Doctor
- Specialist
- Nurse
- Hospital
- Wireless
- Ambulance

OSGi Alliance
2004 World Congress
The Vision (continued)
A Network-based Healthcare Services Platform

- An Open, Standard Healthcare Services Platform with:
  - Remote service management interface
  - Interfaces to in-home sensors and devices
  - Interfaces to physicians, healthcare providers, and medical information systems
  - Service gateway application interfaces (to OSGi service platform)
  - Network-based server application interfaces
Some Issues and Challenges

• Management
  – Network layer QoS
  – Services/Application layer
  – Service development and deployment

• Common Capabilities
  – “Standard”/open device and sensor interfaces
  – Information processing

• Architecture — location of functionality

• Security
In-Home Network Management

FCAPS: Fault, Configuration, Accounting, Performance, and Security

• How do you enable “lights out” operation of the in-home network — e.g.,
  – Plug and Play configuration
  – Automated fault detection and performance management

CableHome and DSLHome efforts begin to address this problem
  – More complete solution prototyped at Telcordia

• Even harder, how do you do this at the services layer?
  – Utton and Scharf propose creating service dependencies based on deployment models (see November 2004 issue of IEEE Communications Magazine)
Service/Application Development and Deployment

An integrated service/application management approach — Adaptive Communicating Applications Platform (ACAP)

A uniform and integrated service development platform for developing and deploying services
Device/Sensor Interfaces

• Need “plug and play” medical device and sensor interfaces
  – Need standard/open APIs and discovery capabilities
  – OSGi service platform APIs would meet this need
• Medical monitoring service “bundles” could then be created/composed — e.g.,
  – Cardiac monitoring:
    • ranges from 3-lead, 6-lead, to standard 12-lead monitoring
    • requires 2 – 9 ECG sensors per patient
    • Required bandwidth per patient ~ 30k b/s – 135k b/s
  – Pregnancy/Fetal monitoring
    • requires 1 - 2 EMG sensor, 1 ECG sensor, 1 temperature sensor per patient
    • Required bandwidth per patient ~ 620k – 1.2M b/s
  – Diabetes monitoring:
    • requires 1 glucose sensor, 1 heart rate sensor per patient
    • Required bandwidth per patient ~ 1k b/s
  – Exercise monitoring:
    • requires 1 heart rate, 1 body temperature sensor per patient
    • Required bandwidth per patient ~ 1k b/s
    • The required bandwidth depends on medical practices and specific sensor product. The above provides order of magnitude.
Information Processing

• Need common capabilities specific to healthcare services applications that could reside on OSGi service platform

• Example — motion artifact removal
  – Collection of behavioral and physiological measurements from individuals during natural behaviors and in natural settings is crucial
    – Ex. Ambulatory monitoring of BP, pulse, EKG, EEG
  – Motion during normal behavior introduces noise into sensors on the surface of the body, making signals difficult to interpret, reducing reliability of measurements, and causing false alarms
    – Exploit multi-sensor correlations
Motion Artifact Removal Example

Use context-based signal processing to treat different motion contexts differently
- Nature of the artifacts will be much different during different behaviors
- Use information from multiple sensors to identify motion context and to characterize the motion artifact within each context
Related Work/Efforts

A lot of activity exists in this area — e.g.,

- Telefonica’s Hogar Digital
- Intel’s Proactive Health
- Center for Aging Services Technologies
- Better Health Technologies
- Medical Automation Research Center at the University of Virginia
- HomMed
- More…
So, what’s needed?

• Lot’s of vertically integrated solutions
• Even some more ambitious trials
• No effort to create an open, “standard” platform/infrastructure currently exists!
Summary

• Enabling Healthcare Service Delivery and Management is another “vertical domain” opportunity for the OSGi service platform
• Growing need in the market for this capability
• Unique research, engineering, and operational challenges
• How do we engage the healthcare community
Any questions…