

Requirements for a Software-Intensive Ecosystem for Telemedicine

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Abstract: Worldwide, public authorities are trying to improve uptake, efficiency and interoperability of ICT support for (telemedical) healthcare services through adoption and enforcement of standards and guidelines, such as IHE XDS and HL7. Furthermore, security concerns are often enforced by requiring services to run inside healthcare VPNs. Finally access control is tailored for authorized healthcare professionals, not citizens. However, closed network solutions along with big and hard to comprehend standards slow down uptake of solutions and access control regimes hold back interaction between initiatives in public and private sectors. With these major challenges in mind, we take inspiration from existing business and software ecosystem approaches and theories and formulate the question: how can we form a dynamic ecosystem of healthcare technology and services in order to allow easier and more flexible development, integration and application of new services, as well as accelerate the adoption of standards and further public/private engagement? Based on a commonality analysis of existing telemedicine solutions and standards in ICT for healthcare, we present functional and quality requirements that should be met for software-intensive ecosystem for telemedicine to be effective. In particular, we argue that i) emphasis on standards must be complemented by reference implementations, ii) an open source service and component approach must be complemented by quality control regime, iii) specifications and architectures must be complemented by provisioning and maintenance support by an ecosystem keystone player, and iv) access control mechanisms must support general access by authorized healthcare professionals as well as personal access by citizens.

Introduction

Telemedical systems in a patient's home promise increased quality of life and less national spending. In Denmark many projects have experimented with video conferencing between clinicians and the patient in his/her home, measurements and upload of data for chronically ill persons, browsing of medicine intake schemas, etc. However, these experiments have all suffered

from having “silo” software architectures: a computer with a special purpose application is installed at the clinician, has its own data repository, and directly connects to a set of computers in the patients’ homes. Thus, no or little interaction happens with public systems, e.g. Electronic Health Records (EHR), and it scales poorly for patients with several diagnoses, as they need several different systems.

In the Net4Care project [2], we research software architectures that will enable small and medium businesses (SMB) to enter the marketplace for telemedical applications. We have surveyed existing products and projects and studied national and international healthcare standards and reference architectures. Internationally, there are standards that promise to ease interoperability like IHE profiles, notably XDS, and HL7 and thus seem like viable platforms on which to implement telemedical solutions. However our analyses show that they pose severe obstacles for SMBs. First, public documentation, if available, is reference documentation for the initiated and overwhelmingly bulky. For example, to our knowledge, it was only in 2010 and 2011 that more general books on CDA and HL7 became available [3,4]. Secondly, reference implementations are generally expensive proprietary systems that inhibit experimentation by SMBs.

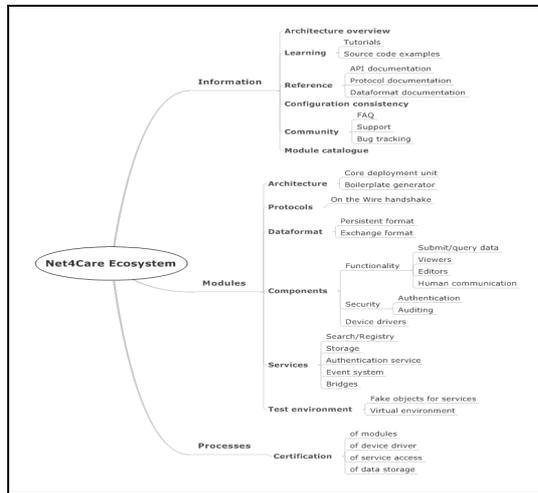
An Ecosystem Approach

In Net4Care we propose to mitigate the learning curve as well as support SMBs’ application development for telemedicine by providing an application-centric *ecosystem for telemedicine* and an *open-source reference implementation* of the core platform. Bosch [1] outlines a set of success factors for application-centric ecosystems: a) large set of customers b) simplified contribution by third party developers c) ability to extend data models and workflows and d) a viable channel of exposure to customers. We hypothesize that few SMBs will enter a marketplace for telemedical applications as existing standards does not fulfill the *simplified contribution* requirement and those who do are unable to interoperate with existing public healthcare solutions, such as EHR systems.

Our ecosystem proposal focuses on the *simplified contribution* and *extensible data/workflow model* requirements as they are prerequisites for *viable market channel* and, ultimately, *large set of customers*. We have been inspired by the success of open source projects like Apache Software Foundation, Eclipse, and Android that have achieved global impact on all scales of software development right from student projects to international business. A major success factor is their *learning resources*, that is,

tutorials, examples, and overview documentation that provide a gentle learning curve, as well as freely available reference implementations. Thus in a couple of hours an independent developer can move from initial exposure to the first executing prototype. The goal of Net4Care is to achieve the same transparency and support for the SMB developer in developing telemedical applications.

Figure 1. shows the areas in which the Net4Care ecosystem is planned to provide value for a SMB. They are classified in three main categories: *information, modules, and processes*.



Figur 1: Areas of support by Net4Care

The *modules* category embodies the platform itself. To the SMB developer, this will be in the form of a framework in a mainstream programming language as well as a test environment of (simulated) servers for initial experimentation. A minimum of clinical vocabulary is assumed (like coding systems for clinical measurements) while the framework handles translations to/from HL7 (personal health monitoring records) and storage in XDS. The *information* category is essential as it is the learning resources that the developers of SMBs will use to quickly initiate application development using the ecosystem. Reference documentation is important but the focus will be more on tutorials and “getting started” guides. Finally, the *process* category embodies certifications of companies and potentially software services before they are permitted to access and run on the Net4Care servers.

Utilizing the Danish National Service Platform (NSP) Net4Care servers will provide secure interoperability with relevant national and regional healthcare systems such as a national XDS Affinity Domain, National Patient Index, and regional EHRs, while exposing a simplified and coherent interface to SMBs.

As the national healthcare system is missing a security policy for integrated telemedical applications, we propose a policy that supports decentralized citizen-based access control to confidential telemedical data [5]. The proposed telemedicine policy aligns the security requirements to the national levels of security including non-repudiation by users/systems as in [6]. In order to fasten the certification procedures we further propose a semi-automated approach for system certification performed by the trusted ecosystem authorities.

Summary

The Net4Care project aims at designing an application-centric ecosystem for telemedical healthcare. We have argued why current standards fall short in supporting SMBs and their attempts to enter a promising market place.

We argue that *simplifying contribution* is vital and have outlined how

Net4Care will try to support this requirement by providing learning resources as well as an open source platform. An initial implementation of the platform is available [7].

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