Open SOA Health Web Platform for Mobile Medical Apps

Connecting Securely Mobile Devices with Distributed Electronic Health Records and Medical Systems

Jörg-Uwe Meyer
MT2IT Research
MT2IT GmbH & Co. KG
Ratzeburg, Germany
joerg-uwe.meyer@mt2it.com
Elements of a Service-Oriented Architecture (SOA)

SOA

Application frontend
(Client, Web Sockets, User Agent)

«Service»
Web Services

Service repository

Service Bus

Contract
(openSDC)

Implementation

Interface
(Web-API)

Business Logic
(Medical and Healthcare Applications)

Data Model
(DIM ISO 11073-10201)

Modified from source:
Components of the Open SOA Health Web Platform for Medical Apps

1. **IT-App Server (ITAS)**
   - Clinical Information System (CIS)
   - EHR
   - Data Model
   - Secure Service-App Proxy (SESAP)

2. **Medical Devices**
   - Devices (e.g., weight)
   - View Model

3. **User Agent**
   - Physician
   - Wound Safety Nurse
   - View Engine
   - App-Messaging
   - Service Bus Communication
   - Workflow Services
On-premise SOA Deployment of open Health Platform
Behind the Firewall

- Firewall

Clients (on-premise)

User (e.g. OR-Safety Manager)

[Diagram of SOA Deployment with Service Bus, Secure Service-App Proxy (SESAP), Client, Web Services, Interface Web-API, Application Software, User Agent, Storage, CIS, IT-App Server (ITAS), MD-App Servers (MEDAS)]
Operation Room Use Case “User Registration”

- User Client
  - User Registration
  - Session Registration
  - Patient Demographics Query
  - Patient Identification

- Authorization Server
- IS Application Software
- IT-App Server
- Clinical Information System
- OR Safety Manager
- User Client
<table>
<thead>
<tr>
<th>UC User Registration</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Activity Sequences</strong></td>
<td><strong>IHE-ITI or HL7 Reference</strong></td>
</tr>
<tr>
<td>1 OR_Safety_Manager initiates through User_Client login page of IS_Application_Software_Component</td>
<td></td>
</tr>
<tr>
<td>2 IS_Application_Software_Component redirects User_Client to Authorization_Server</td>
<td>ITI-71 Get Authorization Token</td>
</tr>
<tr>
<td>3 User_Client sends credentials to Authorization_Server's login page</td>
<td>ITI-71 Get Authorization Token</td>
</tr>
<tr>
<td>4 <strong>Authorization_Server returns single-use authorization code</strong> to <strong>User_Client</strong> and Authorization_Server redirects User_Client back to the IS_Application_Software_Component</td>
<td>ITI-71 Get Authorization Token</td>
</tr>
<tr>
<td>5 IS_Application_Software_Component passes the User_Client's single use authorization code and its own IS_Application_Software_Component's <strong>ID and secret to the Authorization_Server</strong></td>
<td>ITI-71 Get Authorization Token</td>
</tr>
<tr>
<td>6 <strong>Authorization_Server returns access token</strong> to IS_Application_Software_Component</td>
<td>ITI-71 Get Authorization Token</td>
</tr>
<tr>
<td>7 IS_Application_Software_Component uses access token to request OR_Safety_Manager user info from Authorization_Server</td>
<td>ITI-71 Get Authorization Token</td>
</tr>
<tr>
<td>8 Authorization_Server returns OR_Safety_Manager user info to IS_Application_Software_Component</td>
<td>ITI-72 Incorporate Authorization Token</td>
</tr>
<tr>
<td>9 IS_Application_Software_Component confirms appropriate OR Safety Manager's user identification to OR_Safety_Manager</td>
<td>ITI-72 Incorporate Authorization Token</td>
</tr>
<tr>
<td>10 OR_Safety_Manager continues tasks presented by the User_Client</td>
<td></td>
</tr>
</tbody>
</table>
Operation Room Use Case “Session Registration”

IT-App Server

Order Software Component

IS Application Software

User Client

User Registration

Surgery Session Registration

Patient Demographics Query

Patient Identification

Clinical Information System

OR Safety Manager

Order Software Component

Clinical Information System
Workflow Services according to WHO Safety Surgical Checklist

**Surgical Safety Checklist**

**Before induction of anaesthesia**
(with at least nurse and anaesthetist)

- Has the patient confirmed his/her identity, site, procedure, and consent?
  - Yes
- Is the site marked?
  - Yes
  - Not applicable
- Is the anaesthesia machine and medication check complete?
  - Yes
- Is the pulse oximeter on the patient and functioning?
  - Yes
- Does the patient have a:
  - Known allergy?
    - No
    - Yes
  - Difficult airway or aspiration risk?
    - No
    - Yes, and equipment/assistance available
  - Risk of >500ml blood loss (7ml/kg in children)?
    - No
    - Yes, and two IVs/central access and fluids planned

**Before skin incision**
(with nurse, anaesthetist and surgeon)

- Confirm all team members have introduced themselves by name and role.
- Confirm the patient’s name, procedure, and where the incision will be made.
- Has antibiotic prophylaxis been given within the last 60 minutes?
  - Yes
  - Not applicable
- Anticipated Critical Events
  - To Surgeon:
    - What are the critical or non-routine steps?
    - How long will the case take?
    - What is the anticipated blood loss?
  - To Anaesthetist:
    - Are there any patient-specific concerns?
  - To Nursing Team:
    - Has sterility (including indicator results) been confirmed?
    - Are there equipment issues or any concerns?

**Before patient leaves operating room**
(with nurse, anaesthetist and surgeon)

- Nurse Verbally Confirms:
  - The name of the procedure
  - Completion of instrument, sponge and needle counts
  - Specimen labelling (read specimen labels aloud, including patient name)
  - Whether there are any equipment problems to be addressed

- To Surgeon, Anaesthetist and Nurse:
  - What are the key concerns for recovery and management of this patient?

This checklist is not intended to be comprehensive. Additions and modifications to fit local practice are encouraged.

© WHO, 2009

Revised 1 / 2009

IEEE SOCNE Workshop, September 16, 2014
Medical Device Network Communication with Web Service APIs
Extensible openSDC protocol stack for clinical workplace service-oriented medical device architectures

- BICEPS (Message & Service Model)
- MDPWS & DPWS (Transport)

MT2IT Client of openSDC Web-API

Web Services

- SOAP Request-Response
- SOAP-over-UDP
- SOAP Req-Resp + TLS + Authentication
- WS-Eventing

BICEPS Services

- GET
- SET/ACTION
- Waveform
- PHI

EVENT REPORT

‘Java API converted to .NET CIL using IKVM’

Communication MEDAS \(\leftrightarrow\) User Agent \(\leftrightarrow\) SESAP

MD-App-Servers (MEDAS)

Service Providers

Event-Services

Msg.

Services

OR Safety Manager

Client User Agent

Firewall

Patient Identification Services

Workflow 01 Services

Workflow 02 Services

Workflow 03 Services

Other Services

Workflow Services Service Bus

MD-App-Servers (MEDAS)

User Client Safety Manager

Start

Patient identification

Before induction of anesthetics

Before skin incision

Before patient leaves OR

End

© Prof. Jörg-Uwe Meyer, PhD, MT2IT
Web-APIs Communication between User Front-End Client Application und Proxy (Server) Back-End Application
On-premise Deployment Behind the Firewall

- Firewall

Service Bus

Secure Service-App Proxy (SESAP)

Clients (on-premise)

«Device»

User Agent

Application Software

Services

«Server»

«Device»

User Agent

Application Software

«Server»

«Service» Authorization

Interface Web-API

Application Software

Service Bus

CIS

IT-App Server (ITAS)

MD-App Servers (MEDAS)

Msg.

Msg.

Msg.
The Open SOA Health Web Platform for Mobile Medical Apps

Clients (off-premises)

Mobile Environment

Service Bus

Secure Service-App Proxy (SESAP)

Firewall

CIS

IT-App Server (ITAS)

MD-App Servers (MEDAS)

© Prof. Jörg-Uwe Meyer, PhD, MT2IT

IEEE SOCNE Workshop, September 16, 2014
Model View Controller (MVVM) as HMI Front-End

- **View**: HTML5/JavaScript Client as User Front-End
- **View Model**: Near real-time binding (persistent connection)
- **Model**: VM Windows Server Service Bus

Diagram: View to View Model with commands and binding, View Model to Model with update and read connections.
e.g. Mobile Wound Management App on Open Health Platform
Medical Device and Medical Software Standards

IT and Web Standards

- DICOM
- IHE
- ISO
- HL7
- FHIR
- DICOM
- HL7, FHIR, IHE, DICOM
- ISO/IEEE 11073-xxxx
- IEC 62304, IEC 62366
- IEC 80001-xx, ISO/AWI IEC TR 80002-x
- ASTM F2761-1:2009; AAMI / UL 2800 – Family
- IEC 60601-xx-xx
- IEC 62304, IEC 62366
- ISO/IEEE 11073-xxxx
- IEC 80001-xx, ISO/AWI IEC TR 80002-x
- ASTM F2761-1:2009; AAMI / UL 2800 – Family
- IEC 60601-xx-xx

- ISO/IEC 25437:2006 IT – Web Services
- REST/SOAP Web Service Specifications
- Open Data Protocol (OData)
- OAuth 2.0 (RFC 6749)
- Web 2.0, HTML5, JavaScript, ...
- ISO/IEC 25437:2006 IT – Web Services
- REST/SOAP Web Service Specifications
- Open Data Protocol (OData)
- OAuth 2.0 (RFC 6749)
- Web 2.0, HTML5, JavaScript, ...

© Prof. Jörg-Uwe Meyer, PhD, MT2IT
IEEE SOCNE Workshop, September 16, 2014
IHE: e.g. Patient Demographics Query for Mobile


Integrating the Healthcare Enterprise

IHE

IHE IT Infrastructure
Technical Framework Supplement

Patient Demographics Query for Mobile (PDQm)

Date: August 28, 2014
Author: IHE ITI Technical Committee
Email: iti@ihe.net

Benefits Unlocked for:
- Mobile healthcare providers (e.g. hospital staff making rounds)
- Medical devices that can become “smarter” with real-time patient data
“Interoperable Medical Device Interface Safety - the AAMI/UL 2800 Family of Standards” Technical Brief for FDA, MDICC, and the AAMI HITI Committee


e.g. CIS Resource Server and Devices (Smart Phone/ Tablets/ Sensors)

External System

Web-API

Service-oriented Middleware

Service Bus

App Messaging

ICE Supervisor

Workflow Services

Medical Devices (MD)/Systems

Secure Service-App Proxy

Data Logger

Device A

Device B

Device C

A

B

C

App X

App Y

App Z

App “Data Logging”
Thank you for your attention!

Open SOA Health Web Platform for Mobile Medical Apps

Connecting Securely Mobile Devices with Distributed Electronic Health Records and Medical Systems

Jörg-Uwe Meyer
MT2IT Research
MT2IT GmbH & Co. KG
Ratzeburg, Germany
joerg-uwe.meyer@mt2it.com