Secure and Reliable Communication for Telemedical Applications in Emergency Medical Services (EMS)

Dr. Ingo Forkel, Tadeusz Brodziak
15. March 2013, Aachen, 23rd ComNets-Workshop
Outline

1. Introduction
2. System Concept
3. Trial Period Results
4. Conclusion and Outlook
Motivation:
Trends in Emergency Medical Services

- Significant increase in emergency cases over the past years
- Emergency physician’s manual abilities needed in only about 15% of the cases
- In 85% of the cases only his knowledge and decision-making ability required

“Move the information, not the doctor!”

Analysis of EMS response in Germany

Source: Behrendt, Schmiedel (2004)

Introduction: P3’s Projects for Teleconsultation in EMS

- **Med-on-@ix**: 2007-2010
  - Feasibility study
  - Funded by the Federal Ministry of Economics and Technology
  - Evaluation period 1 year (Aachen): 1 tele-EMS-physician / 1 specially equipped ambulance vehicle

- **TemRas**: 2010-2013
  - Pilot study
  - Funded by the EU and the Ministry of Innovation, Science and Research of North-Rhine-Westphalia
  - Trial operation for 1 year (North-Rhine-Westphalia): 2 tele-EMS-physician / 6 specially equipped ambulance vehicle
Introduction: Partner
Introduction:
Approaches for Telemedicine in Mobile Environments

- EMS voice service is based on dedicated EMS radio technologies
- Data transmission is based on single transmission carriers with usage of commercial cellular networks
- Always best connected (ABC) approach with usage of commercial cellular network and WLAN
- ABC approach with additional usage of SATCOM
- ABC approach with simultaneous usage of transmission carriers (e.g. UMTS and WLAN)
- Batch oriented remote data collection is commonplace
System Concept:
Telemedical Rescue Assistance System

On-Scene inside ambulance

On-Scene outside ambulance

Communication Network

TNAZ

Headset
Display
Video camera
Printer
eScope
Touch control panel

in-car-peeqBOX

portable-peeqBOX

MRx

Smartphone

3G

3G

3G

3G

3G

3G

3G

3G

3G

3G

3G

3G

3G

3G

3G

3G

3G

3G

3G

3G

3G

3G

3G

3G

3G

3G

3G

3G

3G

3G

3G

3G

3G

3G

3G

3G

3G

3G

3G

3G

3G

3G

3G

3G

3G

3G

3G

3G

3G

3G

3G

3G

3G

3G

3G

3G

3G

3G

3G

3G

3G

3G

3G

3G

3G

3G

3G

3G

3G

3G
System Concept: Requested Functionalities

- Voice communication
- ECG and vitals
- Photo, video stream
- Documentation, SOP
- System diagnostics, ...

On site  Hospital

Sign up
System Concept: Requested Functionalities

<table>
<thead>
<tr>
<th>Voice Communication</th>
<th>Voice Communication</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECG and Vitals</td>
<td></td>
</tr>
<tr>
<td>Photo, Video Stream</td>
<td></td>
</tr>
<tr>
<td>Documentation, SOP</td>
<td>Sign up</td>
</tr>
<tr>
<td>Diagnostics, ...</td>
<td></td>
</tr>
</tbody>
</table>

Reliability & Usability

On scene!
System Concept: Reliability

- IP communication is based on parallel usage of different carriers of commercial cellular networks
- Data prioritisation on different layers
- Hub concept (inside/outside ambulance)
- Voice communication is based on three different operators
- Automated inspection and recovery of service quality (internet dialup, powercycling modems, failure detection & recovery, ...)
- Usage of 5 GHz WLAN inside ambulance
- Usage of Bluetooth 2.1 for connecting devices to peeqBOX
System Concept: Usability

- Development of a new approach to a voice service in EMS
- One-button-press philosophy
- Reduced size and weight of peeqBOX
- Intelligent power on/off mechanism
- Easy-to-use user interface
**Trial Results: Missions Overview**

Based on indoor RTT measurements during Med-on-@ix project.
Trial Results: Summary

- Significant increase for IP connection availability for indoor usage
- Data bundling approach allows almost always continuously highest service quality for indoor usage
- Due to the TCP reordering issue, implemented scheduling algorithm was not capable of using the best link at any time

Availability of data service is defined as the fraction of time during every emergency case where the ping requests have been successfully responded within a timeout period of 60 s. Presented is the average value over all emergency cases.
Conclusion

- Usage of standard services/products is not applicable in the field of EMS
- Redundancy of communication links is a mandatory requirement for a reliable usage of teleconsultation in EMS
- Technical assistance systems shall adapt to work flow in EMS
- Very easy handling and faultlessness of services are key success factors for user acceptance
Outlook

- Integration of additional access technologies (e.g. SATCOM, LTE, PMR) especially for usage in rural areas
- Evaluation of TemRas data (08/2012 - 07/2013) for different regions
- Expansion of TemRas to 24/7 within Aachen and other districts

<table>
<thead>
<tr>
<th>EMS district</th>
<th>Ambulance station</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cologne</td>
<td>Rettungswache 6 Chorweiler</td>
</tr>
<tr>
<td>Euskirchen</td>
<td>Rettungswache Tondorf</td>
</tr>
<tr>
<td>Düren</td>
<td>Rettungswache Nideggen</td>
</tr>
<tr>
<td>Heinsberg</td>
<td>Rettungswache Hückelhoven</td>
</tr>
<tr>
<td>Aachen</td>
<td>Hauptwache und Rettungswache Süd</td>
</tr>
</tbody>
</table>

- Expansion of TemRas to 24/7 within Aachen and other districts
Your Contact

Germany - Aachen
P3 communications GmbH
Dennewartstr. 25-27
D-52068 Aachen
Germany

USA - New York
P3 Communications Inc.
412 Mt. Kemble Ave., Suite G2
Morristown, NJ 07960
USA

Web
e-Mail: info.communications@p3-group.com
Internet: www.p3-communications.com

Your Contact

Hakan Ekmen
E-Mail: hakan.ekmen@p3-group.com
Phone: +49 151 571 33235

Olaf Gerwig
E-Mail: olaf.gerwig@p3-group.com
Phone: +49 151 571 33248

Peter Seidenberg
E-Mail: peter.seidenberg@p3-group.com
Phone: +49 151 571 33444

Disclaimer
This document contains P3 communications GmbH proprietary information and shall at all times remain the property of P3 communications GmbH. It shall be distributed and used only by the subcontractor staff registered on the distribution list of this document. The subcontractor is not allowed to copy this document without P3 communications GmbH prior written consent. It shall not be used, distributed or copied by any other third party without P3 communications GmbH prior written consent.