TeleMonitoring in TURKEY

Dr. İsmail KAYA
Karadeniz Technical University,
Department of Electrical and Electronics Eng. Trabzon TURKEY
Remote Patient Monitoring and Body Area Network using IEEE 802.15.6

Assoc.Prof. Dr. Ismail KAYA
Communications
KTU

Assoc.Prof. A. Ozgur YILMAZ
Antennas and Propagation
METU,

Prof. Dr. Temel Kayıkcıoğlu
BioMedical Signal Processing
KTU

Dr. Tayfun ÖZDEMİR, USA
Advisor

Monarch Antenna, Inc.
AGENDA

1. Telemonitoring in Turkey: Main Players
2. eNabız Project as ELGA
3. TURKEY in Numbers
4. OECD Data
5. Next Step
6. Remote Patient Monitoring: ETSI SmartBAN Concept
7. Remote Patient Monitoring: IEEE 802.15.6 BAN Standards
8. Status of IEEE 802.15.6 BAN
9. Conclusions
TeleMonitoring in TURKEY: Main Players

1. State owned establishments
   1. Social Insurance Institution (SGK)
   2. State Hospitals,

   State founding for (1) eNabiz data base and eNabiz.com.tr portal, (2) teleTIP, telemedicine portal for remote monitoring. Both portals are open for all citizens. Both projects are continuing from 2014 to 2017.

2. Private Establishments
   1. Tukcell
   2. Vodafone
   3. Avea
   4. TurkTelekom

   All 4 companies have their establishments on telemedicine or eHealth through their M2M communication tasks. But no noticeable application yet.

3. Hospitals: Some private hospitals support remote blood sugar and heart rate tracking's. Yet there is no announcement for servicing through teleMonitoring
eNabız (electronicECG) portal

Have more than gets about 200 to 500 new registrations every day since 4 April 2015

2000-5000 visits every day

Data Base is fully complaint to HL7.
TURKEY in Numbers

Population : 78 Million %50 is younger than 35

Income level on the average : 13.200 USD

70 million GSM and 3G/4G subscriber
%42 of population was Internet User in 2012.

*44 million beneficial from Social Security Institution (SGK)*
*12 million beneficial from State Pension Institution (ES)*

23 million diabetic illnesses *(December 2015, HIMSS in Istanbul)*
6 million people with cardio vascular diseases *(December 2015, HIMSS in Istanbul)*
Health Status in Turkey

According to the report OECD Health Statistics 2014 How does Turkey compare?

In 2012

Income level on the average : 13.200 USD

77% of health spending was funded by public sources.

70 million GSM and 3G/4G subscriber

Total health spending accounted for 5.4% of GDP, well below the OECD average of 9.3%.

44 million : Social Security Institution (SGK)

1.8 doctor per 1000 population, and well below the OECD average of 3.2.

23 million diabetic illness

6 million people with cardio vascular disease
TeleMonitoring in TURKEY

Next Step

(1), Government is willing to complete teleMonitoring network by the end of 2017 and establish remote patient monitoring portal/facilities as soon as possible. which reduces to cost of medicine (about %30-40) and lightens the workload of hospitals and transportation as well.

(2), Private hospitals enjoys state funding's for the patient care as state hospitals but, no commitment for telemonitoring as state hospitals

(3) Positions of Telecom companies, Vodafone, Turkcell, Avea and TurkTelekom are unknown, but they are willing to get involved on remote patient monitoring since their investments are on the broadband communications through 3G or 4G technologies. But here, a technology is required more flexible and RELIABLE interface with body sensors, i.e. BT, ZB etc.

Where Telecom companies needs to invest more on non-profitable technologies, i.e. BT ??
## Remote Patient Monitoring: (1) Radio Technologies

<table>
<thead>
<tr>
<th>Radio</th>
<th>WIFI/WLAN</th>
<th>Bluetooth 1, BT 2.1, BT 4</th>
<th>IEEE 802.15.4, ZigBee, Wireless Hart, CyFi</th>
<th>IEEE 802.15.6 SmartBAN/ETSI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency Band (GHZ)</td>
<td>2.4-2.485, 5.6-5.8</td>
<td>2.4-2.483</td>
<td>2.4-2.483</td>
<td>2.4-2.483 +2.36-2.4</td>
</tr>
<tr>
<td>Emitted Power</td>
<td>200 mW</td>
<td>20 mW</td>
<td>4 mW</td>
<td>1 mW</td>
</tr>
<tr>
<td>Power Consumption (mW)</td>
<td>1000</td>
<td>70</td>
<td>30</td>
<td>? , 13</td>
</tr>
<tr>
<td>Data Rate (KB/s)</td>
<td>54000</td>
<td>752-24000</td>
<td>250</td>
<td>600-1000</td>
</tr>
<tr>
<td>Availability</td>
<td>%90-100</td>
<td>%70-90</td>
<td>%1</td>
<td>-</td>
</tr>
</tbody>
</table>
Remote Patient Monitoring: (2) ETSI view (SmartBAN)
Remote Patient Monitoring: 3 ETSI view (SmartBAN)
Remote Patient Monitoring: (3) ETSI view (SmartBAN)
Remote Patient Monitoring: IEEE View (IEEE 802.15.6)

- ECG + respiration + accelerometer + temperature
- IEEE 802.15.6 sensor nodes
- SPO2
- IEEE 802.15.6 BAN (HUB) USB based at the moment
- Optic, ADSL, 3G etc
- Personal Computer
  Remote Patient Monitoring Software

Main Data Base
Or Health Information Cloud

PC, PDA or GSM
Phone

Weight, sugar level, blood pressure interfaced directly with the local PC

Main Server
Health Centre
Remote Patient Monitoring : IEEE View (IEEE 802.15.6)

Status of IEEE 802.15.6

1. Radio (transceiver) is not available.

2. Communication protocol is implemented by only IMEC from HOLLAND but no hardware.

3. Our work is to implement IEEE 802.15.6 protocol stack using AT86RF233 which covers 2.36 to 2.83 GHz (However the data is spreaded using IEEE 802.15.4 DSSS technique).

4. Our expected performance is less than %1 PER using diversity which is around %6 percent for non diversity (like ZigBee with no diversity).

5. Implementation 400 kbits/s data, 8 m, 1 mW transmit power 12 mw of power consumption. (while ZigBee is 32 mw, BT is 60 mW)

6. MAC layer protocol stack is fully complaint with IEEE 802.15.6.
CONCLUSIONS

For the telemonitoring in Turkey:

1. Government adapts state health services and hospitals to eNabız portal.
2. Universities and university hospitals are not willing to involve at the moment.
3. Private hospitals keep their own data independently but in HL7 format.

For the remote patient monitoring:

1. Work is required to standardize sampling statuses for sensors.
2. Work is required to implement really a low power radio.
3. Machine learning may well be implied big data as well as regional or personal data.
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Thank You