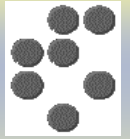
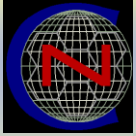


# Sensor Networks in Telemedicine and Telecare

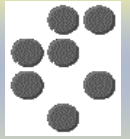


**Aleksandra Rashkovska, Matjaž Depolli, Ivan Tomašič, Viktor Avbelj,  
Roman Trobec**  
Jožef Stefan Institute, Department of Communication Systems,  
Ljubljana, Slovenia

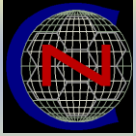
- Why the need for Telemedicine and Telecare?
- How ICT contribute in the idea for Telemedicine and Telecare?
- Where Sensor Networks come into play?
- Where do we see a possible SME involvement?
- What can be OUR contribution to this idea?



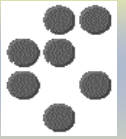
# Medicine & ICT - Telemedicine and Telecare



- Health care organizations Today
- Innovative changes and re-organization are needed
- ICT Today
- **Medicine & ICT - Telemedicine and Telecare**

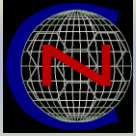


# ICT in Telemedicine and Telecare

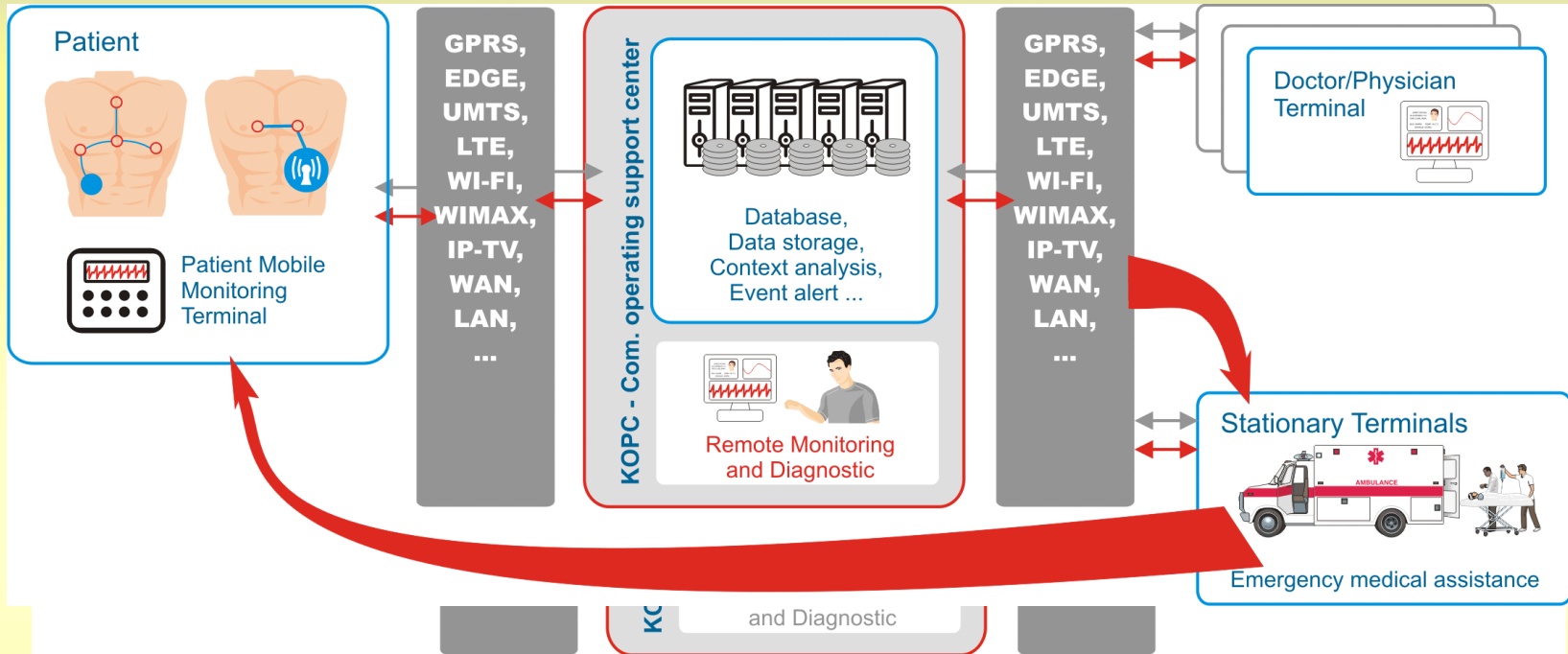
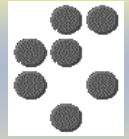


## Contributions of ICT:

- ICT applications as support
- Enable remote treatment
- General health care information and monitoring for users by themselves
- Epidemiological research

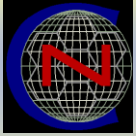


# Telemedicine and Telecare

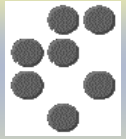


**Test case 1** - Telemedicine and telecare for postoperative monitoring and rehabilitation:  
Neurology - telestroke, Psychiatry - telecare system for the elderly,  
Trauma, Surgery, etc.

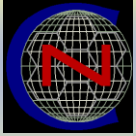
**Test case 2** - Urgent alerts and emergency medical assistance and support.



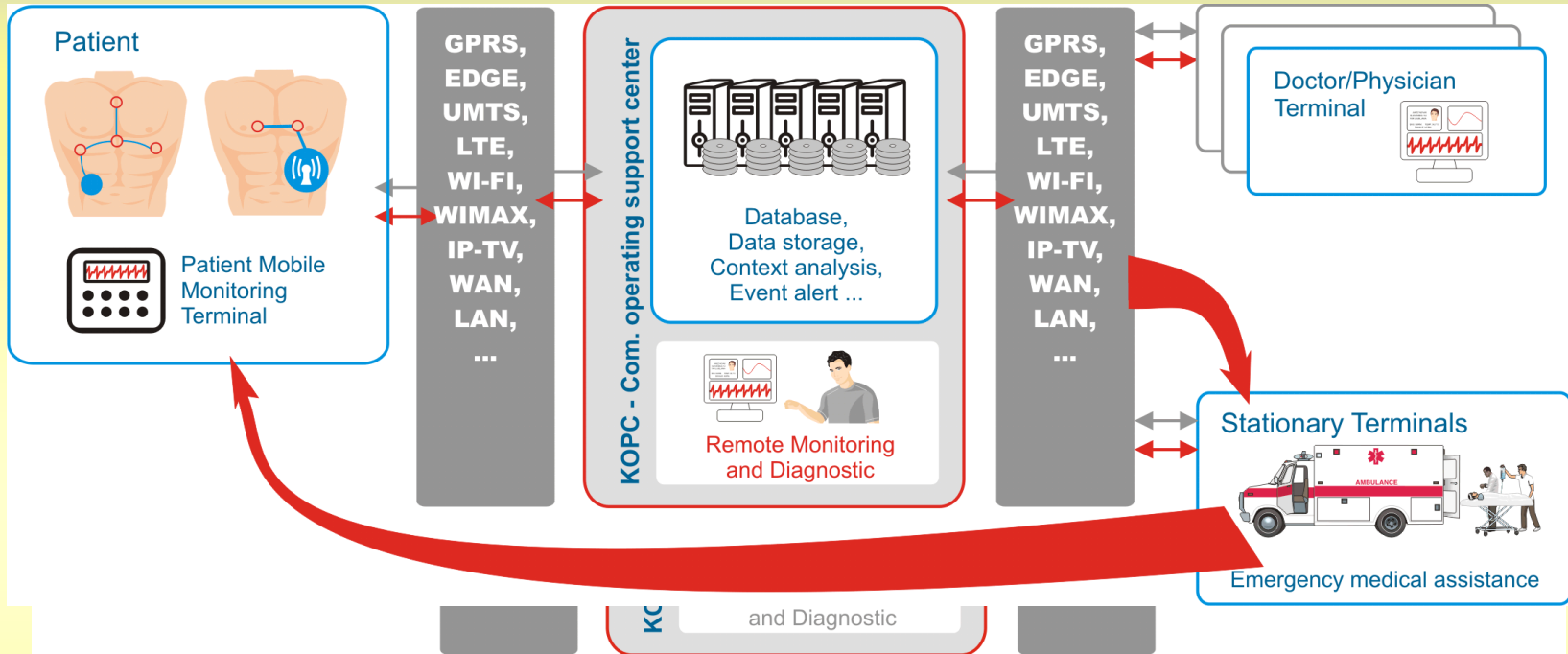
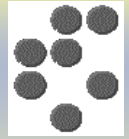
# WSN in Telemedicine and Telecare



- **Body Sensor Networks (BSN) – sources of data**
  - In hospital
  - In operating room
  - At home
- **Wearable Body Sensor Networks (WBSN)**
  - Small, light, convenient
  - Extremely low power consumption
  - Local data analysis
  - Small number of body sensors, Efficient communication protocols, ...
- On the same wireless electrode other sensors can be incorporated:
  - ECG, EMG, body temperature, skin resistance, humidity, position, velocity, blood, pressure ...
- Applications:
  - Neurophysiology, Psychology , Cardiology , Sport

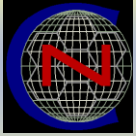


# Telemedicine and Telecare

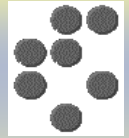


**Test case 1** - Telemedicine and telecare for postoperative monitoring and rehabilitation: Neurology - telestroke, Psychiatry - telecare system for the elderly, Trauma, Surgery, etc.

**Test case 2** - Urgent alerts and emergency medical assistance and support.



# Possible involment of SMEs

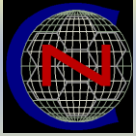


- A national demonstration system - primary, secondary and tertiary level
- SME - different implementation approaches of the sensor layer

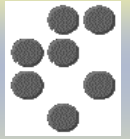
Sensor and  
ICT layer



Patiens/users  
data base  
layer

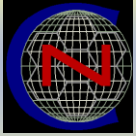


# Wearable Body Sensors - Wireless biopotential electrode (WBE)

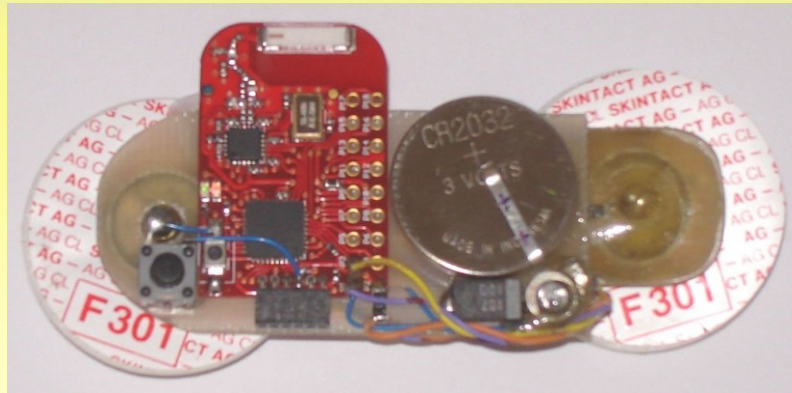
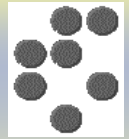


- Wireless electrodes:
  - No wire for the transmission of data
  - Wires on the body?
  
- Biopotential measurements logic – wires are still needed
  
- Wireless technology and wearing comfort: special design of a wireless biopotential electrode:
  - Two close wired electrodes (5 cm)
  - Small number of WBE, low power consumption, noise reduction
  - Local data analysis

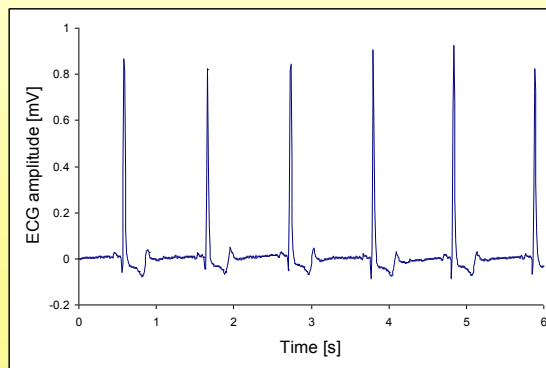




# Wireless biopotential electrode (WBE)

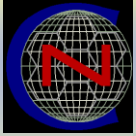


| 5 cm |

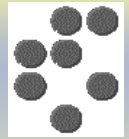


- The prototype of WBE: two self adhesive electrodes, radio, battery and signal amplifier.

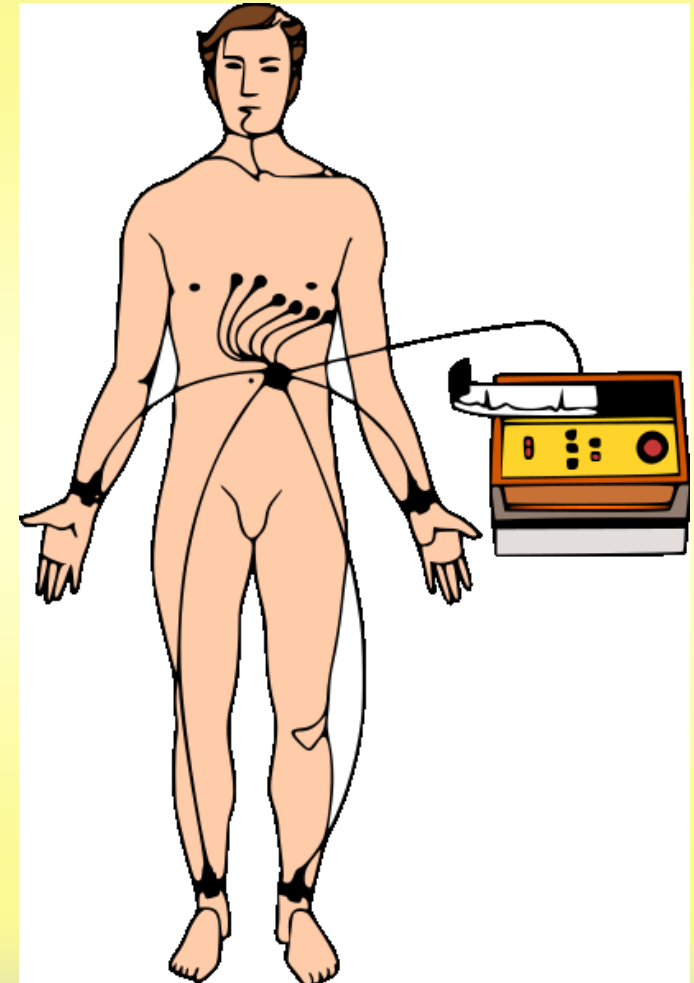
- An example of an ECG recorded wirelessly
- Two self adhesive disposable electrodes used – raw signal

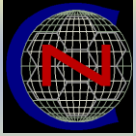


# 12-lead ECG – Standard diagnostic tool

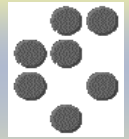


- Standard 12-lead ECG (6 precordial + 4 limb electrodes -> 6 limb leads)
- In 12-lead ECG a lot of redundant information is present.
- Theoretically: only three orthogonal electrodes would suffice.
- Which are the proper positions and the number of WBE electrodes?

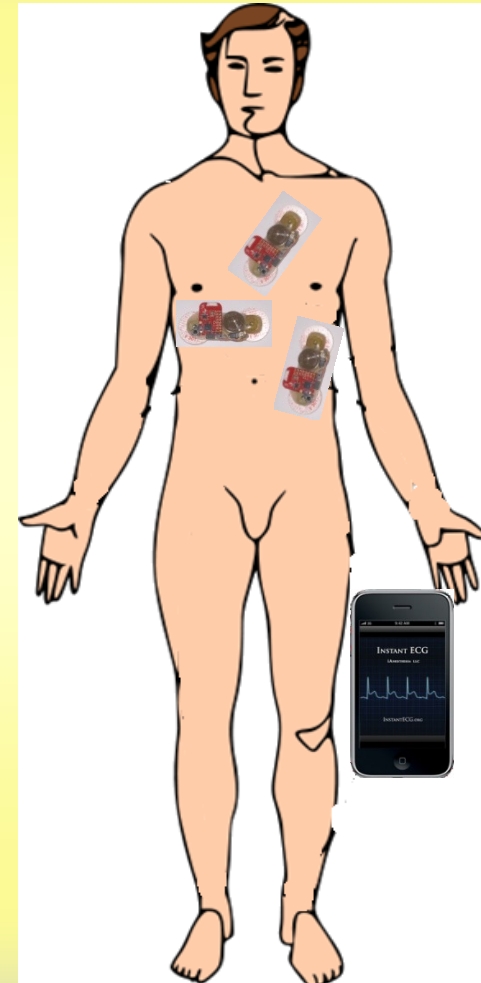


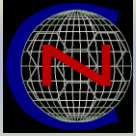


# Reconstruction of a standard 12-lead ECG from 3 WBE

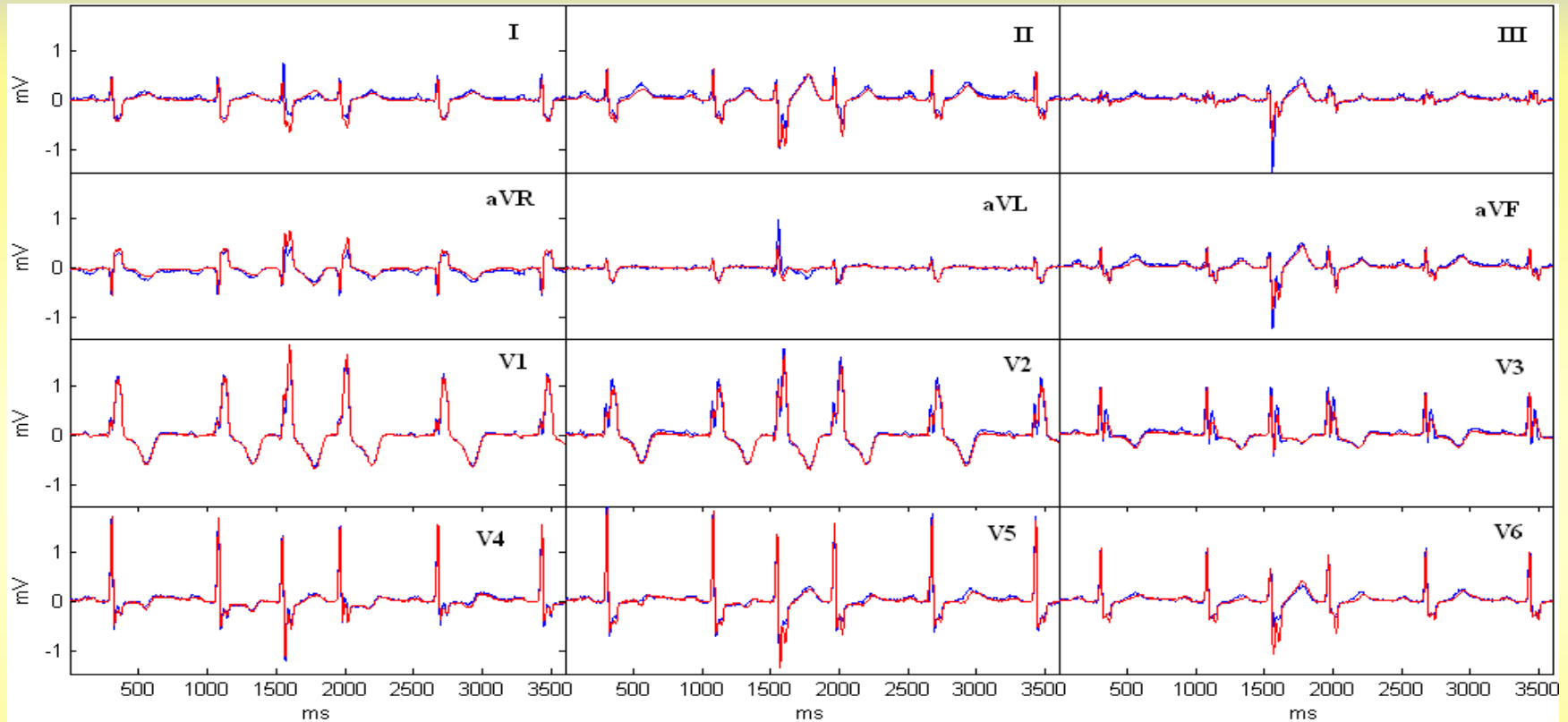
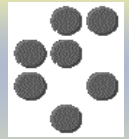


- Multi-channel ECG for analysis
- Our prove:  
Reconstruction of a standard 12-channel ECG from 3 bipolar ECG electrodes
- Significant data compression!
- Our proposal:  
Small personal terminal saves (and displays) the measured data continuously
- Data are sent if necessary to a diagnostic centre.



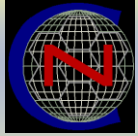


# Reconstructed standard 12-lead ECG from 3 WBE

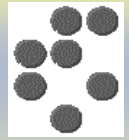


**Control:** Target ECG (blue) and the reconstructed (red) 12-leads ECG, using only 3 WE on positions previously shown.

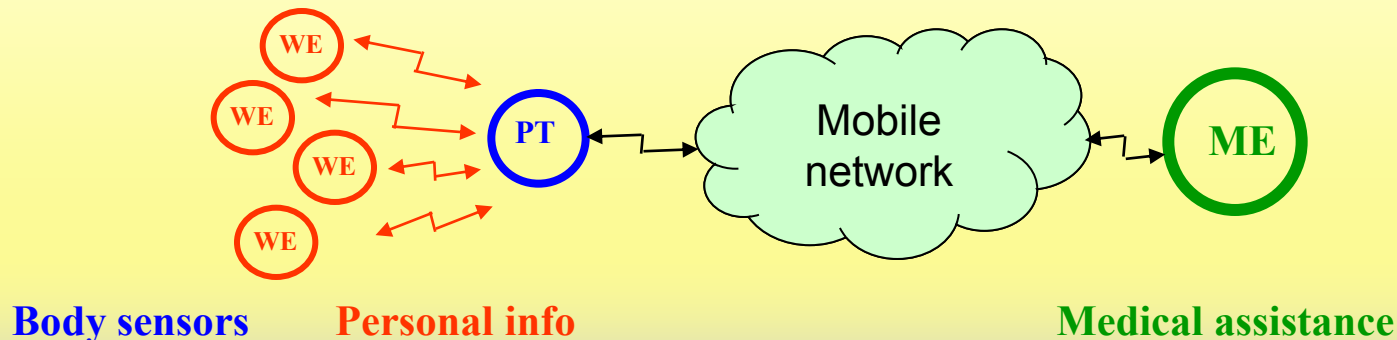
There are also other positions with acceptable output.

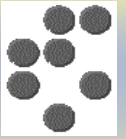
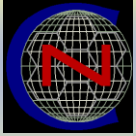


# Know-how still needed



- Local, **on-line data analysis** and **compression**
- Data transfer from bipolar electrode (wired or wireless) (WE) to the system unit (SU)
- **Data transfer** from WE to the personal terminal (PT) – **routing on the body.**
- **Data analysis and presentation** in PT.
- **Data transmission** to the medical center (ME) (existing infrastructure)
- Users' **data base** and **cost** model.





**Thank You for your attention.**