

Body Sensor Networks Lab (WS 17/18)

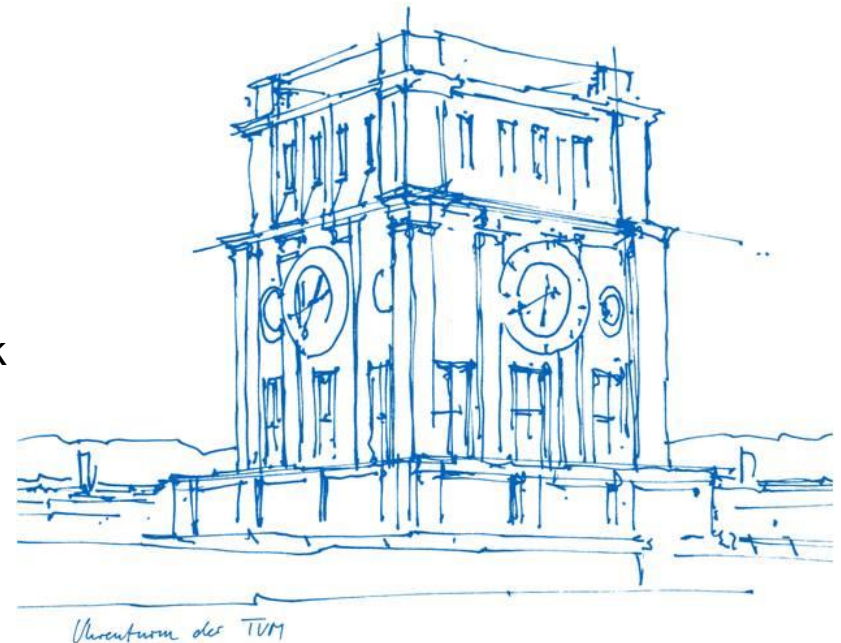
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- Introduction to Body Sensor Networks
 - What are Body Sensor Networks?
 - System architecture
 - Fields of work
 - Differences between Wireless Sensor Nodes and BSNs
 - Challenges in BSNs
 - Sensor examples
 - RCS – Hardware
 - Activity detection
- Short tutorial on Gantt chart
- Organizational
 - Group formation
 - Repository access provision

Formal definition (IEEE 802.15)

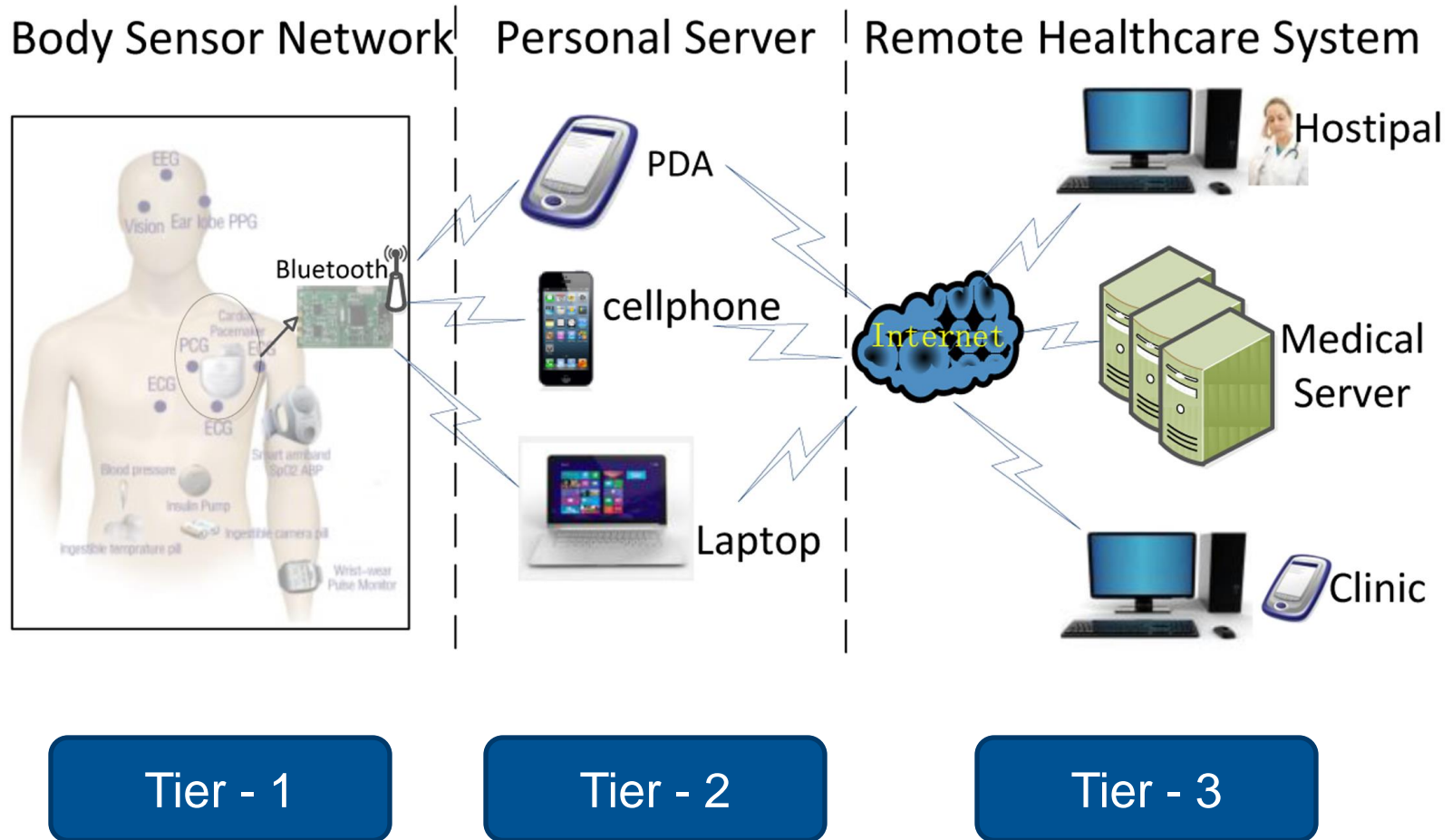
"A communication standard optimized for low power devices and operation on, in or around the human body (but not limited to humans) to serve a variety of applications including medical, consumer electronics / personal entertainment and other "

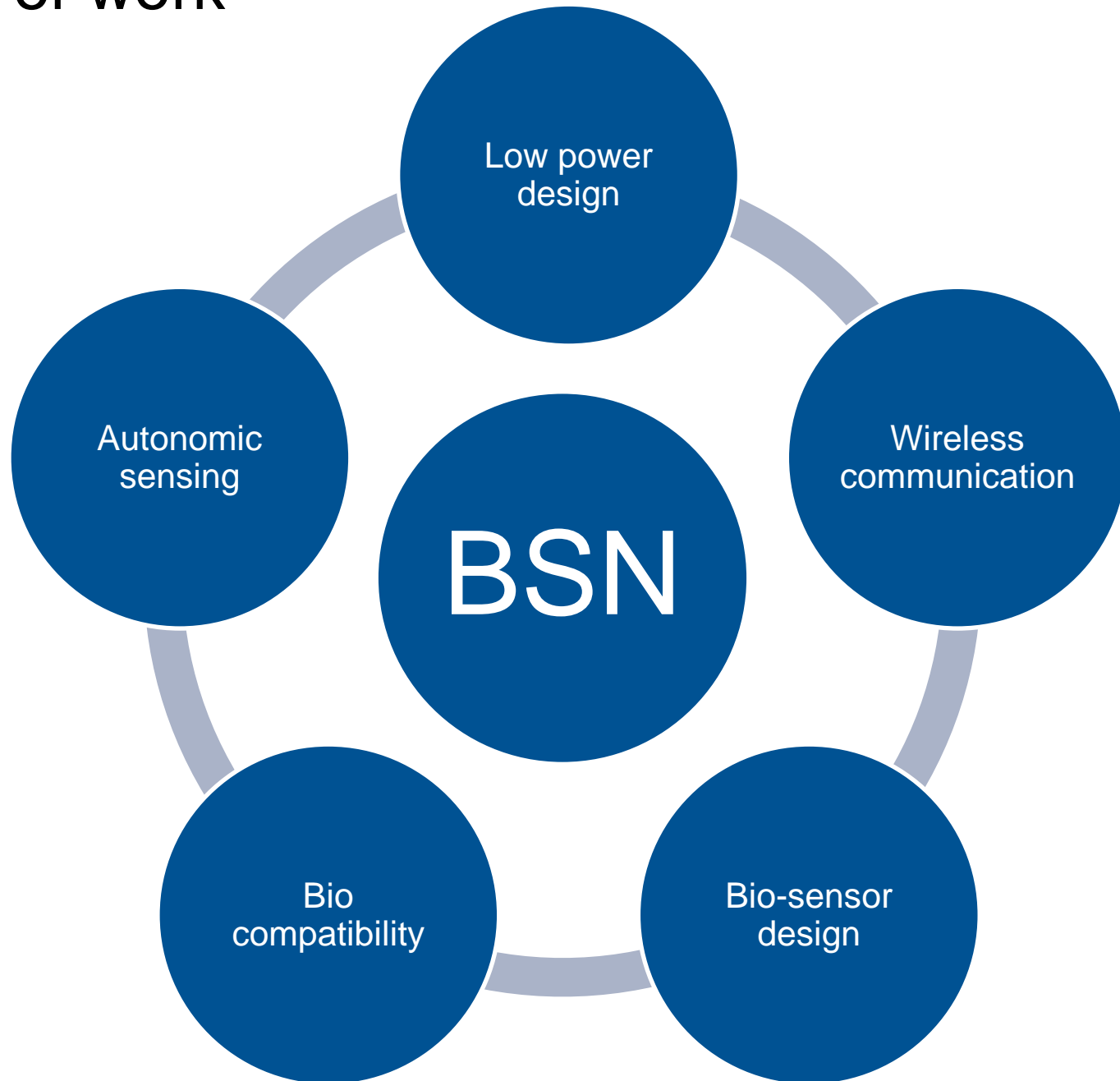
In common terms

"A Body Area Network is a system of devices in close proximity to a persons body that cooperate for the benefit of the user "

- Body Sensor Networks
 - Monitoring of body functions for medical and sports purposes
 - Several sensors for monitoring specific body functions
 - Blood sugar, blood pressure
 - Heart rate, ECG
 - Eyes, eyes implant
 - Data transfer
 - From sensor to a body gateway attached on the body
 - From there to central intelligence nodes
 - Broadcasted to appropriate medical facilities via wireless or wired transfer

System architecture (3-tier architecture)





WSN

- Cover the environment
- Large number of nodes
- Multiple dedicated sensors
- Lower accuracy
- Small size not limiting factor
- Resistant to weather,
- Resistant to noise
- Resistant to asynchrony
- Early adverse event detection
- Failure reversible
- Fixed structure

BSN

- Cover the human body
- Fewer sensor nodes
- Single multitasking sensors
- Robust & Accurate
- Miniaturization
- Pervasive
- Predictable environment
- Motion artefacts an issue
- Early adverse event detection
- Failure irreversible
- Variable structure

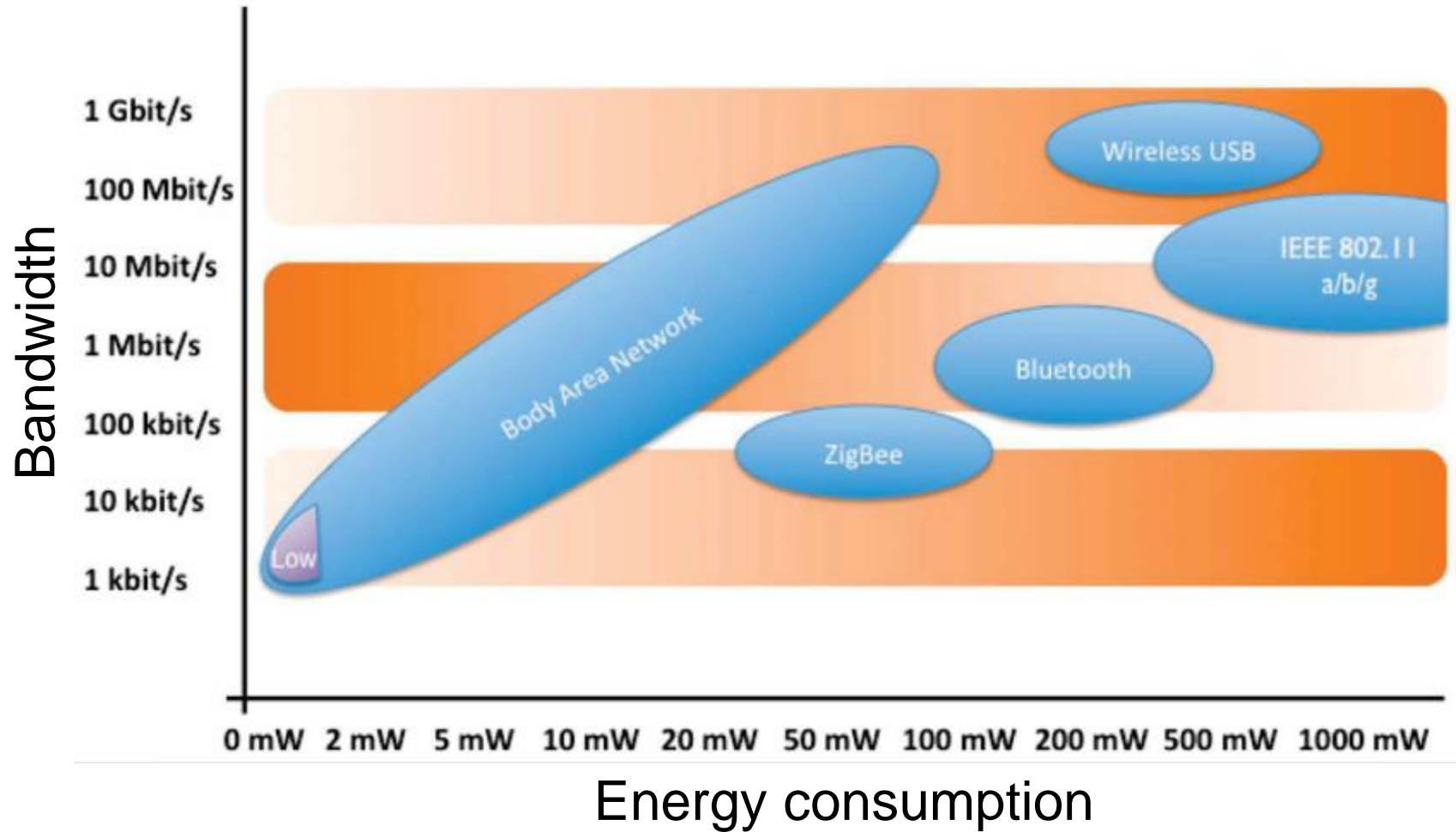
WSN

- Low level security
- Accessible power supply
- High power demand
- Solar, wind power
- Replaceable/disposable
- No biocompatibility needed
- Low context awareness
- Wireless solutions available
- Data loss less of an issue

BSN

- High security
- Inaccessible power source
- Lower power availability
- Thermal, piezoelectric energy
- Biodegradeable
- Biocompatible
- High context awareness
- Lower power wireless
- Sensitive to data loss

Energy consumption vs. Datarate



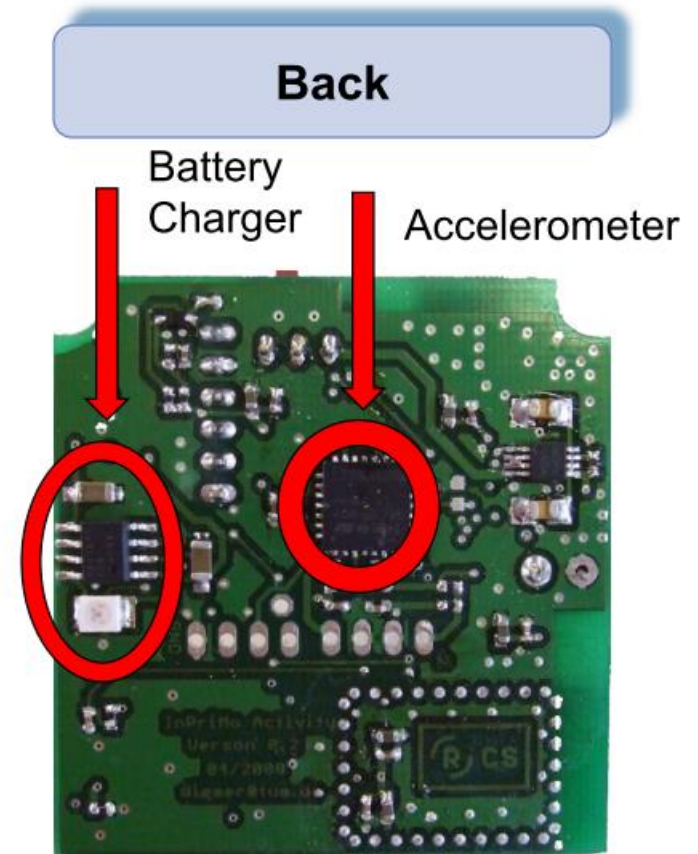
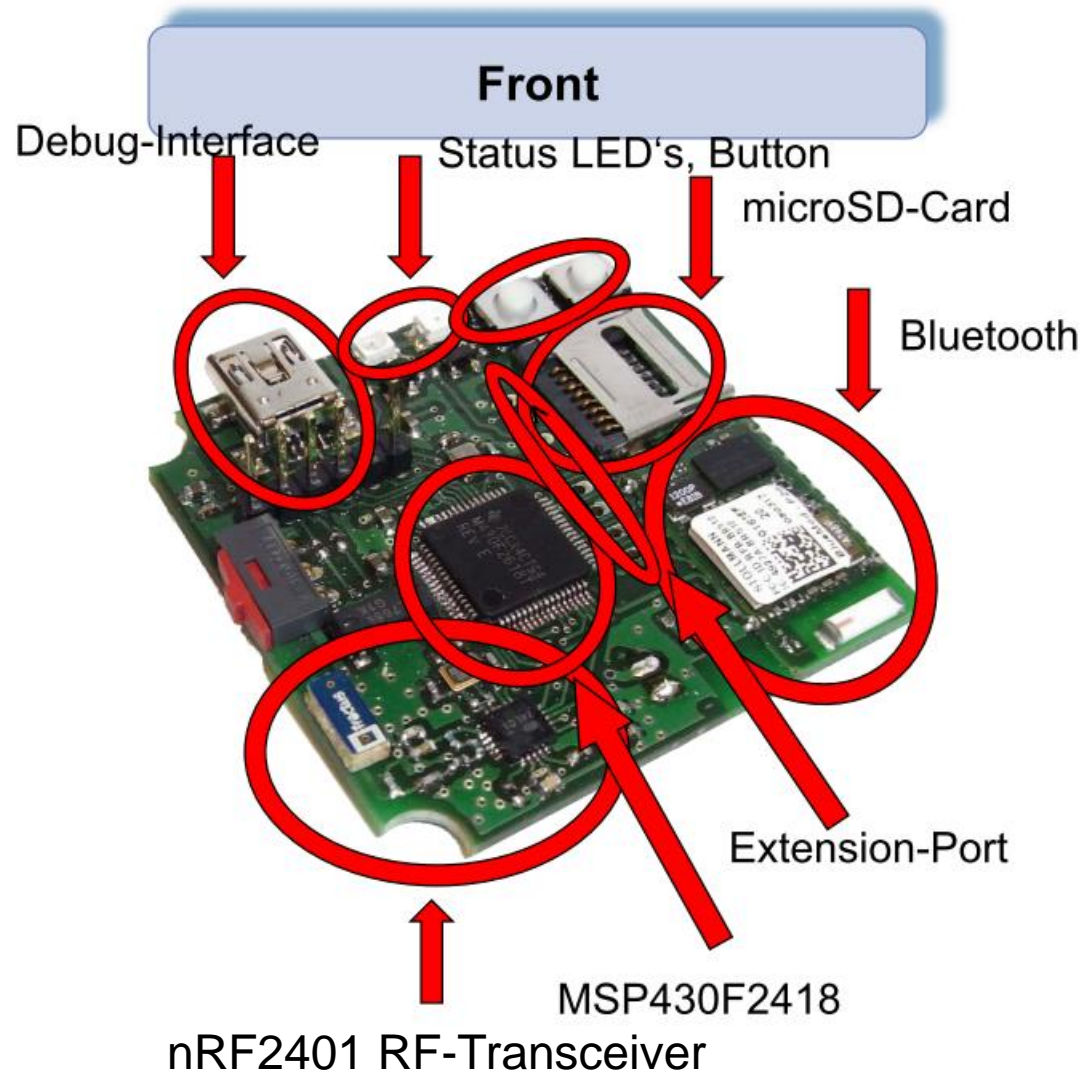
Challenges in Body Sensor Networks

Parameter	Challenges
Power consumption	Ultra low-powered devices are required.
Idle listening time	Synchronization of all devices as per stimuli.
Packet collision and retransmission	During sudden outburst of stimuli, large volume of network traffic that requires smooth flow without collisions.
Bandwidth utilization	Bandwidth is limited due to the data handling capacity of BSNs. So effective use of bandwidth is critical.
Data storage	Challenging if the device size is also small. Distributed storage could be helpful.
Security	Operational resources are highly restricted. So high-level security protocols can lead to large overhead.
Synchronization	Final transmission to control room requires high-level of synchronization. Otherwise leads to delays, time lag and increased processing steps.
Prediction	Based on historical data certain algorithms for predicting health issues are required for its real success (heart attack).

Example sensors

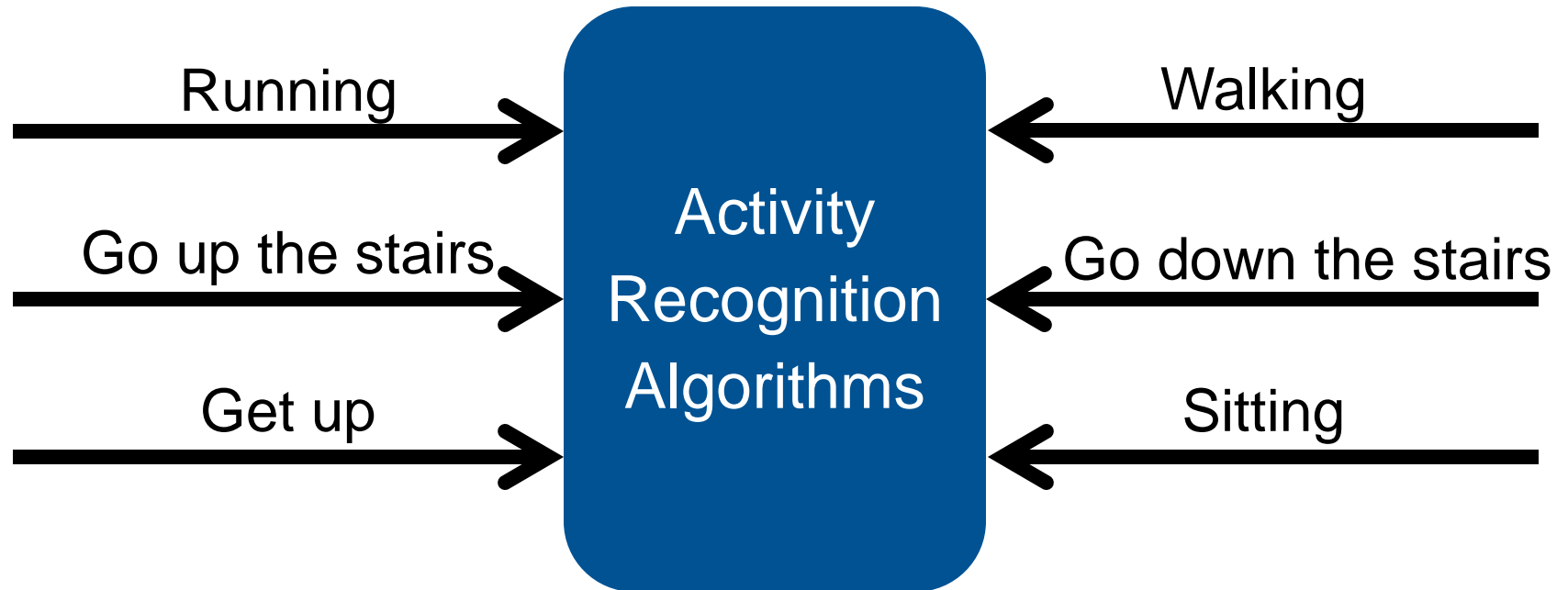
- Breathing
- Pulse rate monitoring
- Body temperature detection
- EKG
- Blood oxygen (SpO₂)
- Blood pressure
- Blood glucose content
- Motion sensors and analysis
 - Pedometer
 - General movement of certain limbs
 - Accelerometer

RCS Sensor Node Hardware

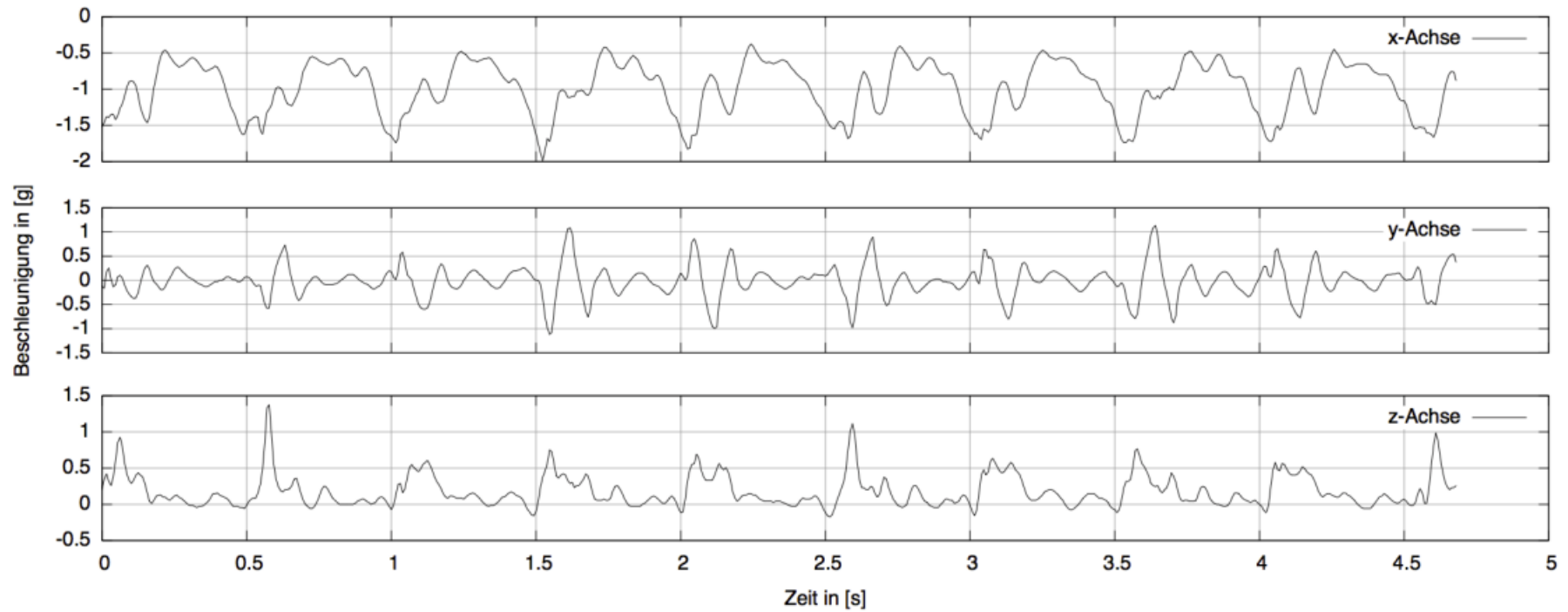


Technical Data

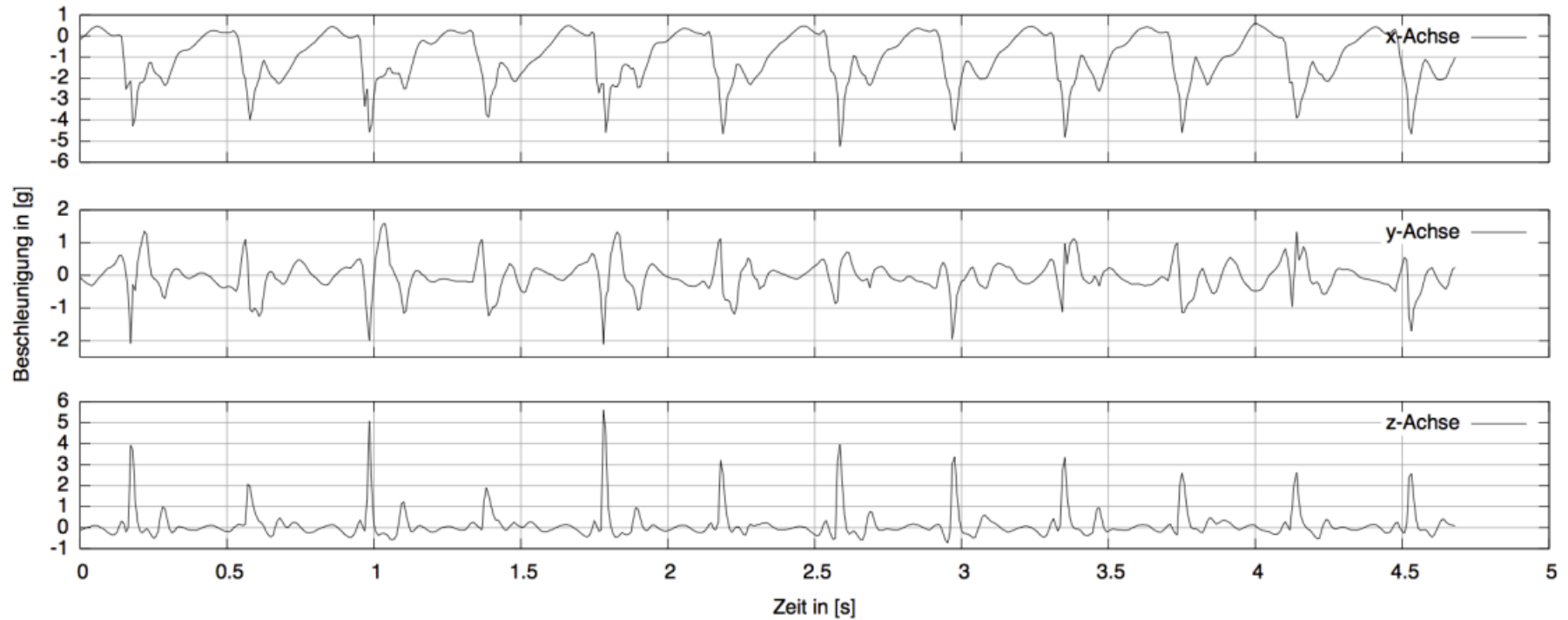
- Microcontroller
 - Texas Instruments: MSP430F2418
 - Ultra-low power consumption (0.5 μ A – some mA)
 - Up to 16 MHz
 - 8 kBytes of RAM
 - 120 kBytes of Flash
- 3D – Accelerometer
 - ST – Microelectronics: LIS3LV02DQ
 - Range: -2g to +2g or -6g to +6g
 - Less than 0.8 mA @ 3.3 V in active mode, less than 10 μ A in power-down mode
- RF Technology
 - Bluetooth module include Health Device Profile (HDP)
 - nRF24L01 (Nordic Semiconductors)



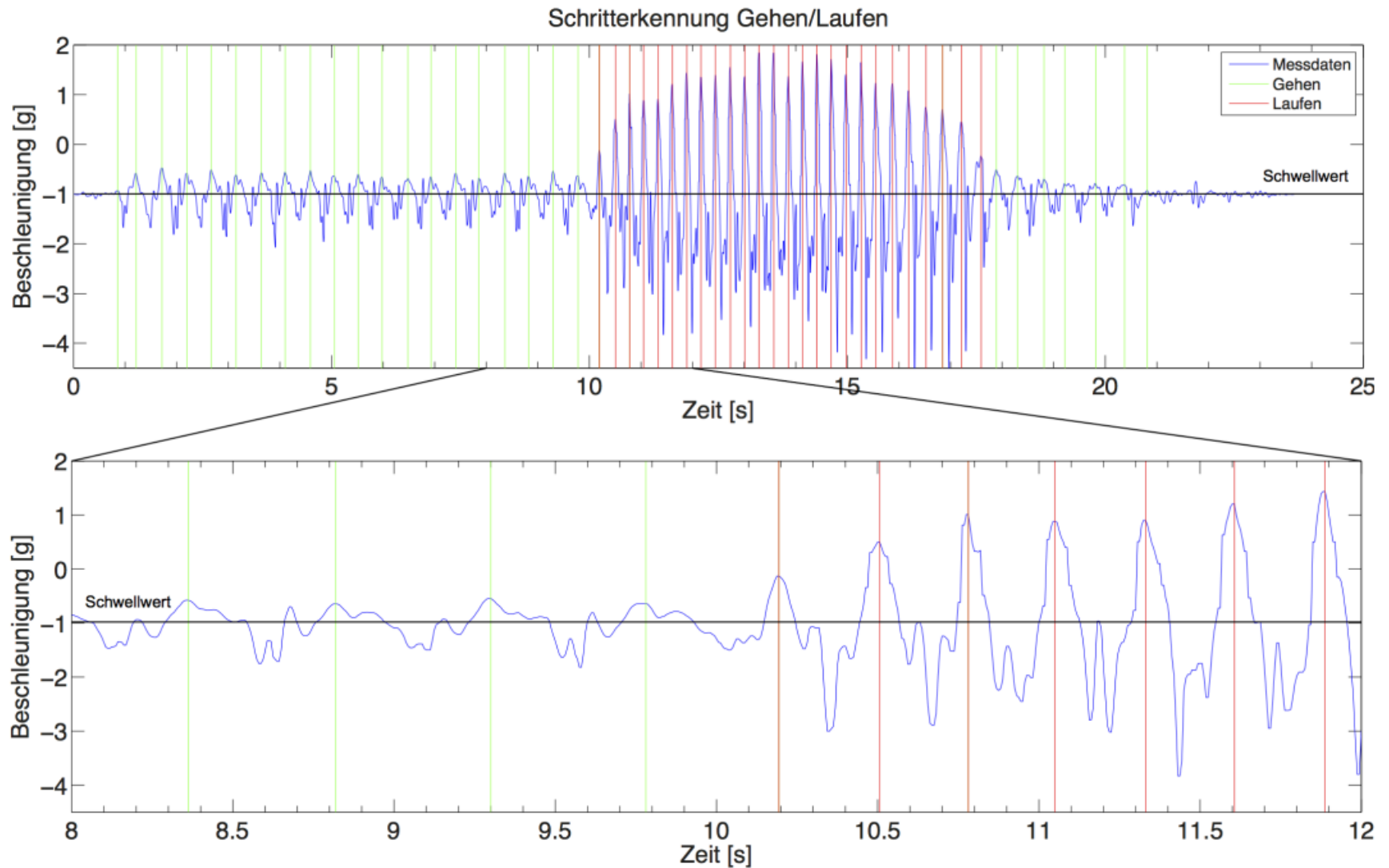
Acceleration data “Walking”



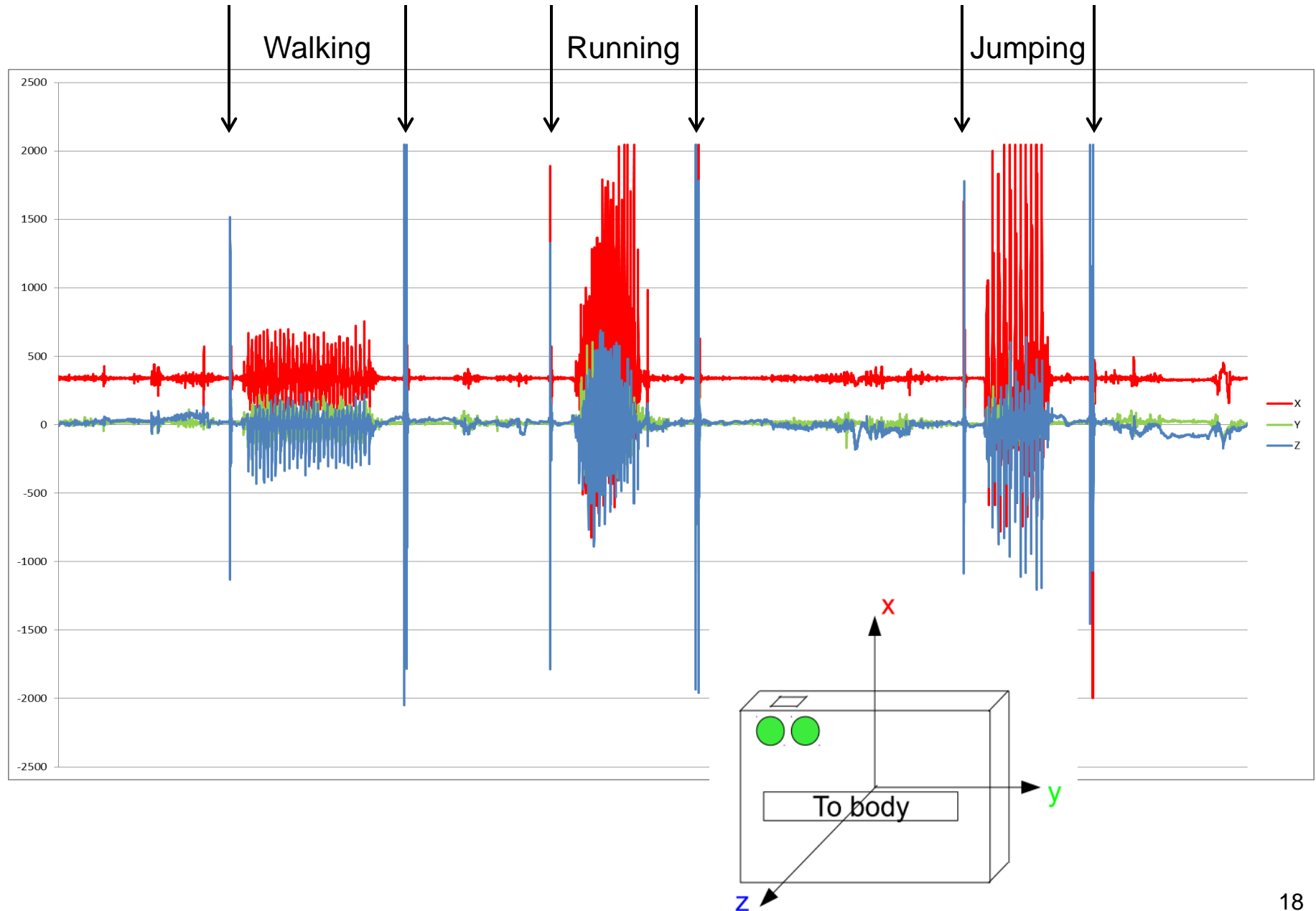
Acceleration data "Running"



Activity detection



Activity detection example

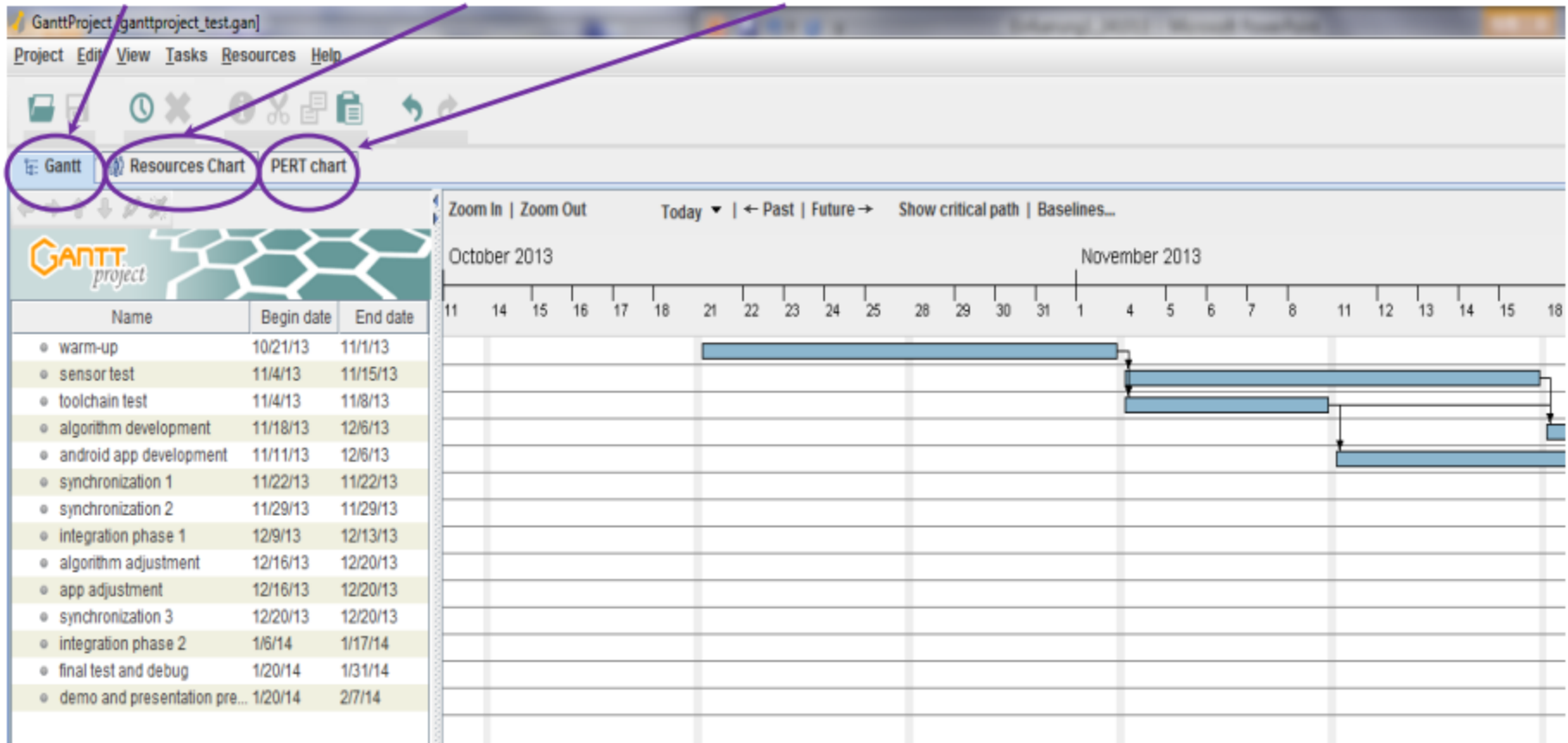


Gantt Project - Overview

Gantt Chart

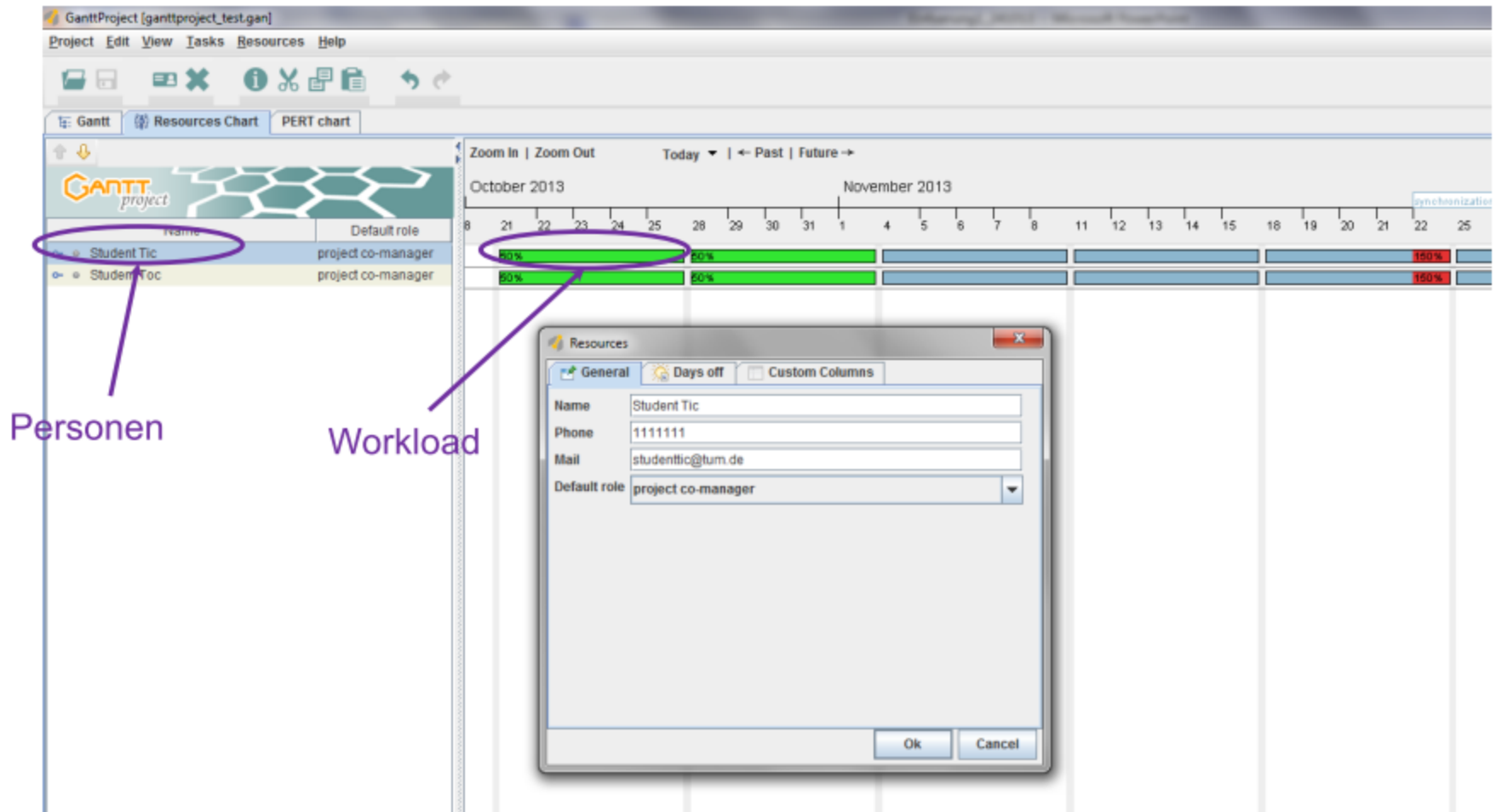
Resource Chart

PERT Chart



Gantt Project – Resource chart

- Resource - Person

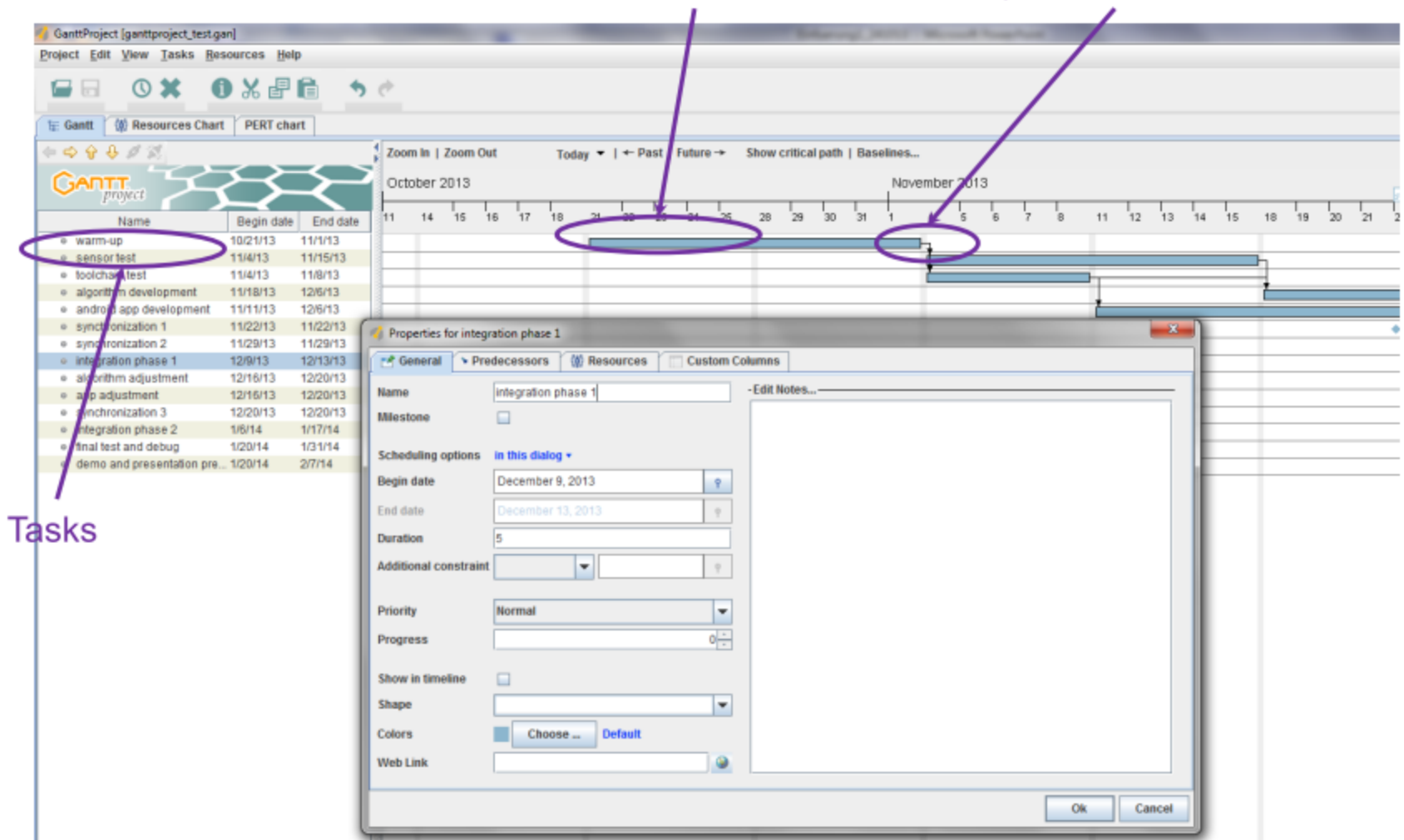


Gantt Project – Gantt chart

- Gantt chart - Tasks

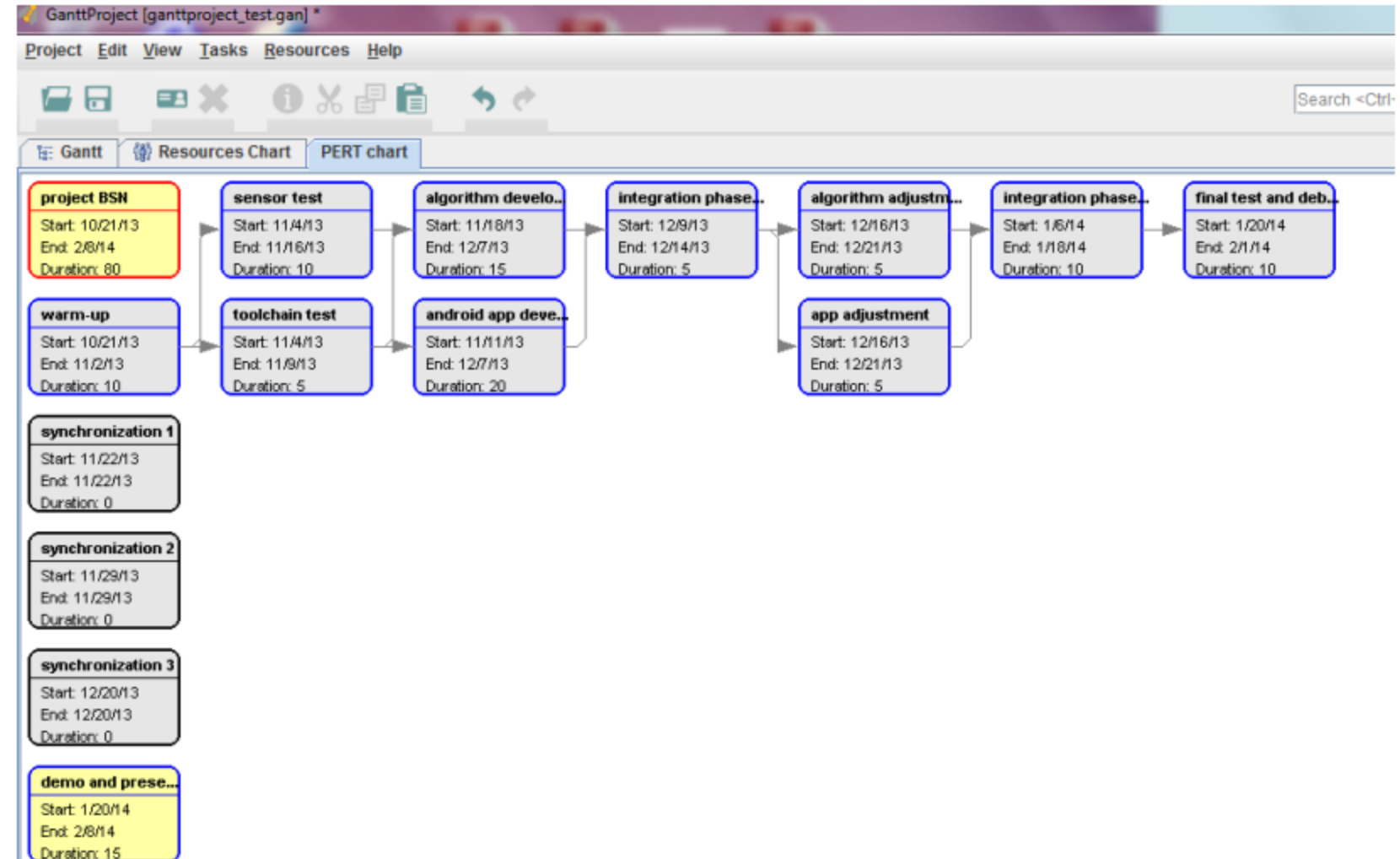
zeitlicher Verlauf

dependencies



Gantt Project – PERT chart

- PERT Chart – Task flow and dependencies



Gantt Project Links

- Ganttprojkt: <http://www.ganttproject.biz>
- Tutorial:
<https://www.youtube.com/watch?v=5rHCSa5ad34&feature=youtu.be>