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Body Area Network

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Group 20

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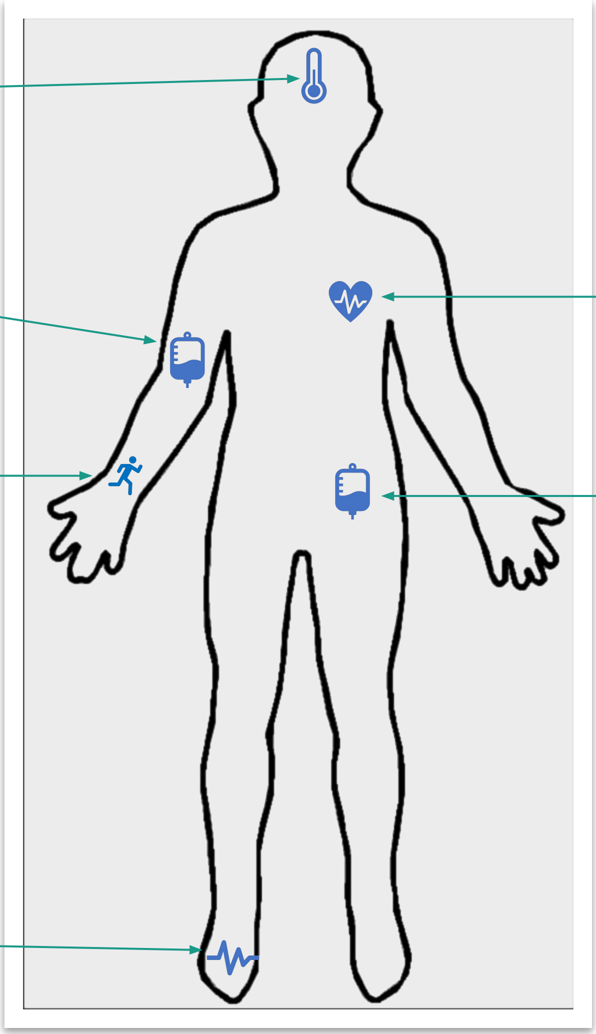
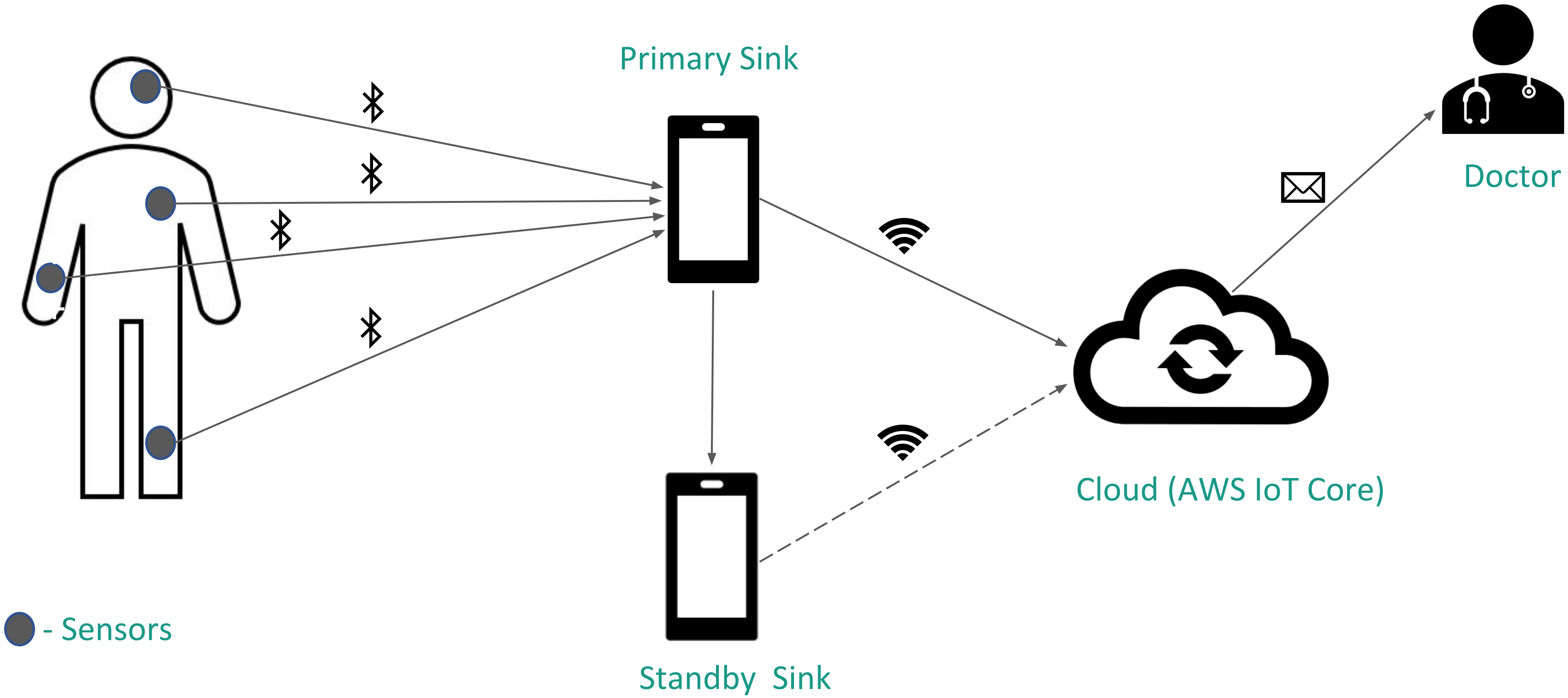

Temperature Sensor
Blood pressure
Fall/Motion Detection Sensor
Pulse Oximeter
Pacemaker
Blood Glucose Sensor

Workflow Diagram



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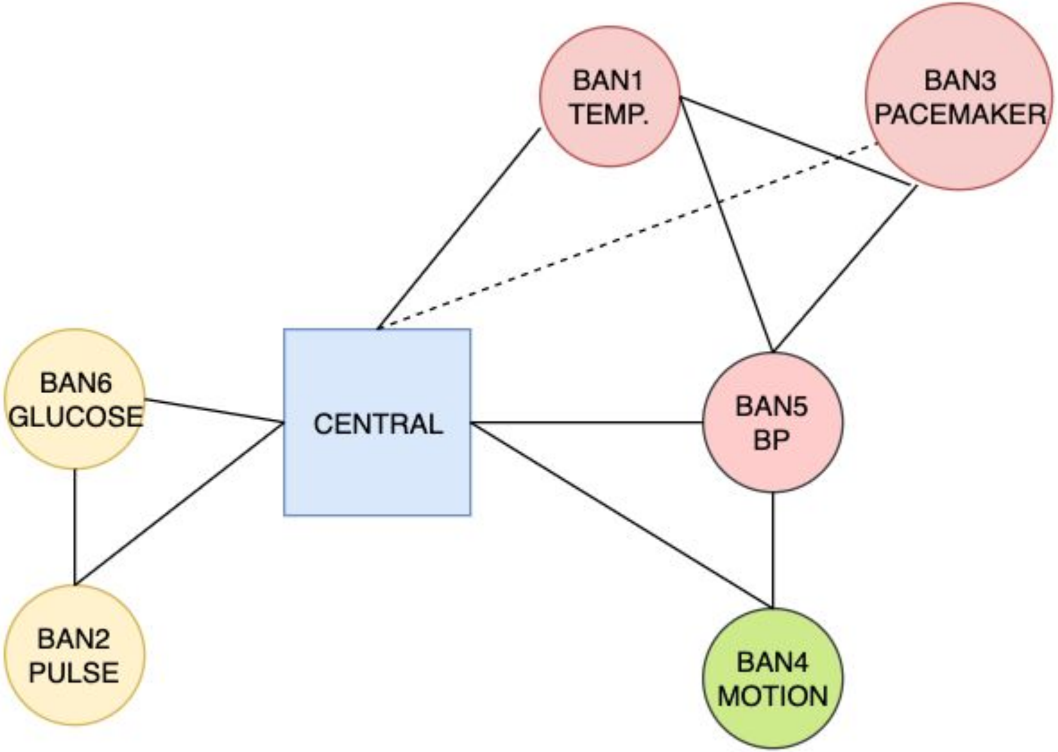
Sensors & Data Sent

Sensor Type	Location on Body	Data to be sent	Normal Range
Temperature Sensor(BAN1)	Forehead	Temperature, Battery Percentage	35.-37.2 degree Celsius
Pulse Oximeter(BAN2)	Left Wrist	Pulse rate per Minute, Battery Percentage	60-100 beats per minute
Pacemaker(BAN3)	Inside body(heart)	Breathing rate, heart rate Battery Percentage	Breathing rate- 12-25 Heart rate-60-100 bpm
Fall Detection/motion-accelerometer (BAN4)	Left Foot	Fall detection, Battery Percentage	0-20 cm
Blood pressure(BAN5)	Left Arm	Systolic BP, Diastolic BP, Battery Percentage	Systolic- 90-140 mmHG Diastolic- 60-90 mmHG
Blood Glucose Sensor(BAN6)	Abdomen	Blood glucose level, Battery Percentage	4-6mmol/dL (72-108mmol/dL)
Primary Sink(BAN7) & Stand-by Sink(BAN8)		**BAN9 & BAN10 are back-up nodes and in idle state**	

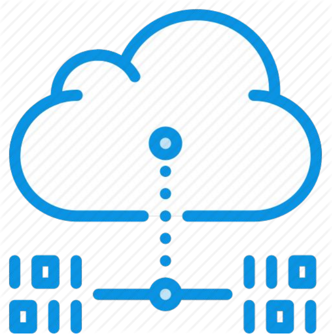
Topology


BAN1
TEMP.
BAN3
PACEMAKER
BAN6
GLUCOSE
CENTRAL
BAN5
BP
BAN2
PULSE
BAN4
MOTION

Comparisons of wearable wireless networks

	IEEE 802.11a/b/g/n (WiFi)	IEEE 802.15.1 (Bluetooth)	IEEE 802.15.1 (Bluetooth-LE)	IEEE 802.15.4 (Zigbee)
Modes of Operation	Adhoc, Infrastructure	Adhoc	Adhoc	Adhoc
Radio Frequencies (MHz)	2400, 5000	2400	2400	868/915, 2400
Power Consumption	High (~ 800 mW)	Medium (~100 mW)	low (~10 mW)	Low (~60 mW
Maximal Signal Rate	Up to 150 Mb/s	Up to 3 Mb/s	Up to 1 Mb/s	Up to 250 Kb/s
Communication Range	Up to 250 m (802.11n)	100 m (class 1 device)	Up to 100 m	Up to 75 m
Topology size	2007 devices for structured Wi-Fi BSS	Up to 8 devices per Piconet	Up to 8 devices per Piconet	Up to 65,536 devices per network
Target Applications	Data Networks	Voice Links	Healthcare, fitness, beacons, security, etc	Sensor networks, home automation, etc
Target BAN Architectures	Off-Body	On-Body	On-Body	Body-to-Body, Off-Body

Communications



- All the sensors will send the corresponding collected data to the user’s mobile device which will act as a sink
- Sensors inside the body (pacemaker, cochlear implant) will communicate with the sink via BLE(Bluetooth Low Energy)
- Sensors on the body will communicate with the sink via BLE
- Sink will collect the data from all the sensors and dump it to the cloud on some predefined frequency (12 hours /24 hours)
- On receiving certain sensor data which is outside of normal range, sink would notify the discrepancy to doctor or user’s emergency contacts via email/text message

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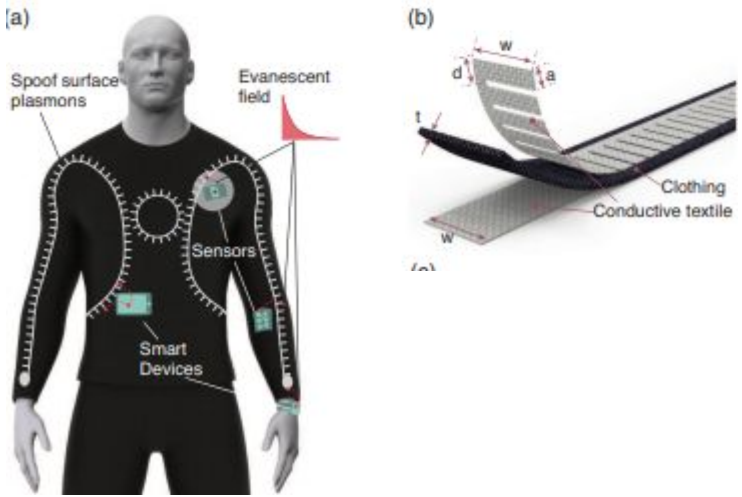
Spoof Surface Plasmons on Clothing

- Enables high-efficiency propagation of wireless signals by guiding propagation around the curved and dynamic environment of the human body.
- low-cost conductive textiles
- low power wireless communication
- longer battery lifetimes



Robust and High-Efficiency Wireless Body Area Networks with Spoof Surface Plasmons on Clothing Xi Tian, Mengying Zhang, and John S. Ho* , Department of Electrical and Computer Engineering, National University of Singapore, Singapore * johnho@nus.edu.sg

Power

- The internal body sensors such as pacemaker cannot be recharged and come with one-time usage of up to 5 years.
- External sensors used will be charged through wired connections. We can use supercapacitor for sensors battery instead of rechargeable battery since it has almost unlimited charging cycles, and its efficiency of charging and discharging is higher than that of a battery[1].
- Sink used is the mobile device and is powered regularly. In case of sink is down, backup sink will be active and receive the data from sensors.
- We are using double sink and our primary sink will send the battery signal to the secondary sink and when the primary is down, secondary can take over.

[1]F. Wu, C. Rüdiger, M. R. Yuce, "Real-time performance of a self-powered environmental iot sensor network system", *Sensors*, vol. 17, no. 2, pp. 1-14, 2017.

Failover Scenarios and Mechanism

- What will happen if one of the sensors stops working ?
  - As sensors send data to sink at some predefined intervals, so if the sink does not receive the data from a particular sensor ,it would alert the doctor/emergency contacts of the user about the same.
  - As sensors can communicate with each other (P2P), sensors' data is replicated in the network to avoid any data loss.
- What will happen if the sink goes down ?
  - We have a backup sink node in place which will act as the primary sink in that particular situation.
  - So when the sink goes down and sensors are unable to connect to it, the sensors would establish connection with the backup sink and send data to it.

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Demo

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Questions?