# Assessing the suitability of ultra-low power WiFi modules to build Body Area Networks

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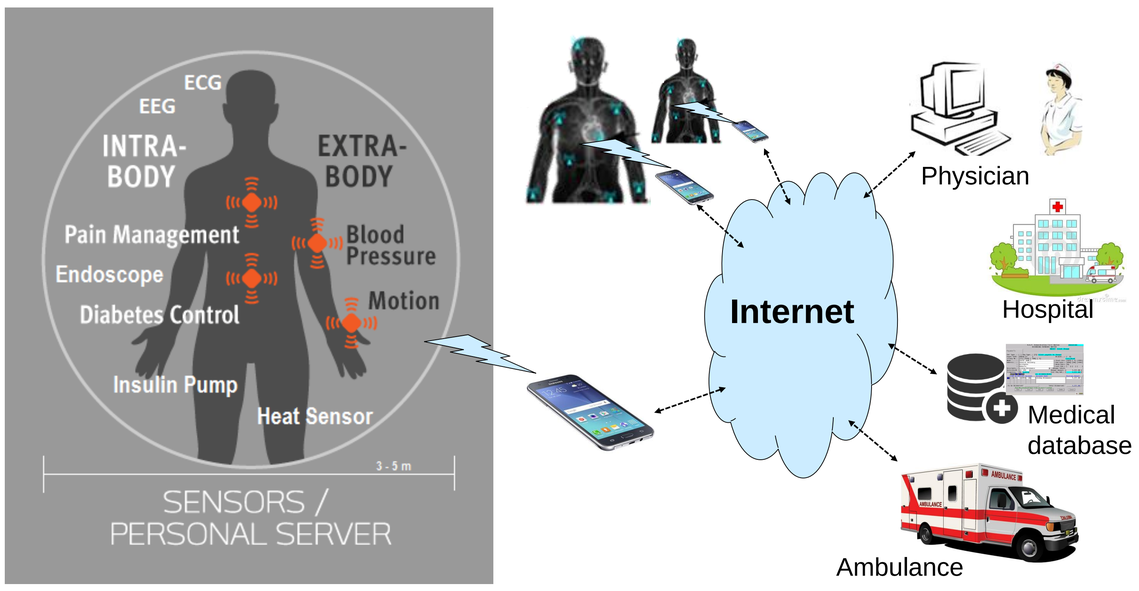
## Context and Motivation

The **NanoStima** project - *Macro-to-Nano Human Sensing: Towards Integrated Multimodal Health Monitoring and Analytics*

Usage of **Body Area Networks** (BANs) to collect individual health data and feed the Health Big Data system

BANs have been using **specific low power networks**, such as Bluetooth




## Why trying WiFi technology

**Pros**

Direct **integration** in WLANs possibly **skipping gateways**

Facilitates **connectivity**

Potential **lower cost**

**Cons**

High **power** consumption

**Size** of the interfaces

**Complex** protocol

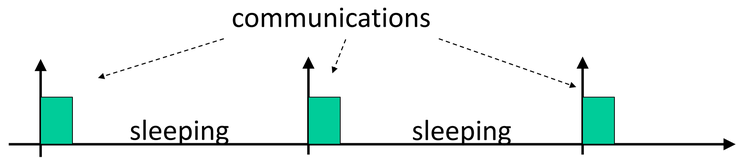
**Security** concerns

## Proposed solution

Use new **ultra-low power** highly integrated **WiFi** nodes such as the **ESP8266**

Use duty-cycling with **sleep-wake up cycles** to save energy

Explore **synchronous frameworks**, e.g., DTIM standard feature or **RA-TDMA** overlay protocol, for **low duty-cycle** operation




## The ESP 8266EX nodes

Tensilica **L106 Diamond** series **32-bit** processor @ 80MHz

**36kB** of on-chip **SRAM**

**4MB** of external SPI **Flash** memory

**IEEE 802.11b/g/n** with **TCP/IP** stack

Several IO pins and functions

**3 sleep modes**, with consumption down to **10uA**

**Fast sleep/wake** context switching

Active average consumption of **80mA**

## Synchronous frameworks: DTIM *vs* RA-TDMA

**DTIM** → standard feature in **Access Points** to deliver data to mobile nodes; requires AP; timeliness enforced by AP

**RA-TDMA** → overlay protocol, better suited to ad-hoc mode; dynamic **reference election**; **synchronous sampling**; transparent synchronization of multiple **similar networks**

## Challenges

**Synchronization** in the presence of interference

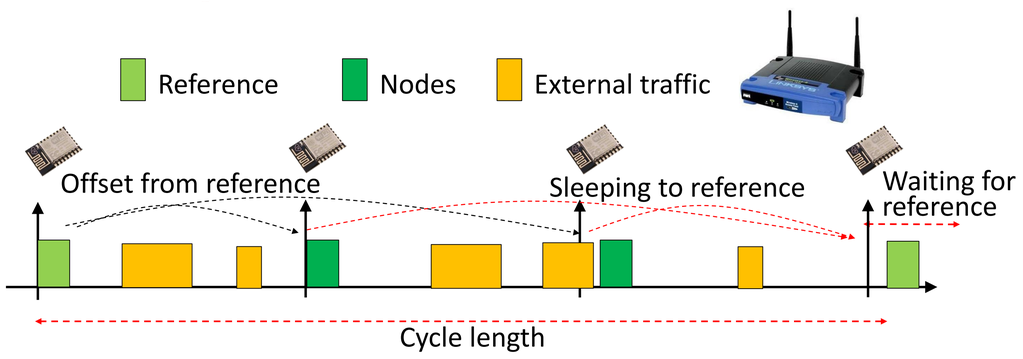
**Power control** to minimize range / crosstalk

**Security** in such constrained nodes

**Control** and **Internet** connection architecture

**DTIM and RA-TDMA** combination

## Preliminary results




Initial set up attempting to combine DTIM and RA-TDMA

Power consumption estimates with 3ms per transmission and 10ms per reception, with a cycle of 1s (**~1,3% duty-cycle**), lead to **~0,5mA.h**. On an ordinary **lithium battery**, this is about **18 days** of consecutive operation with 1s sampling.

## Conclusion and ongoing work

The NanoStima project is based on extensive use of BANs and we believe these can benefit from using WiFi technology. This entails several challenges to achieve sufficient autonomy and security which we are currently addressing to carry out a full comparison with currently disseminated technologies.

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