

Ultra Low Power 1V Transceiver Suitable for Body Sensor Networks

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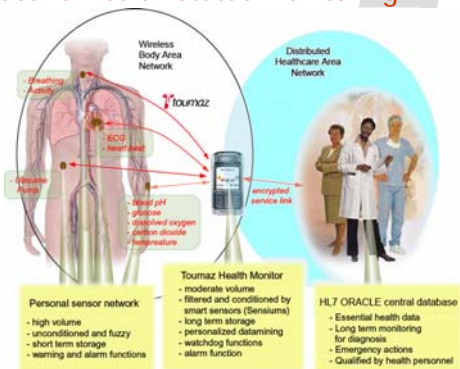
Presentation Outline

- Body-worn sensor node for health status monitoring – the Toumaz ‘Sensium’
- Sensium requirements for body-worn applications
- Wireless transceiver implementation choices
- Transceiver system architecture for BSN applications
- 1V transceiver hardware implementation



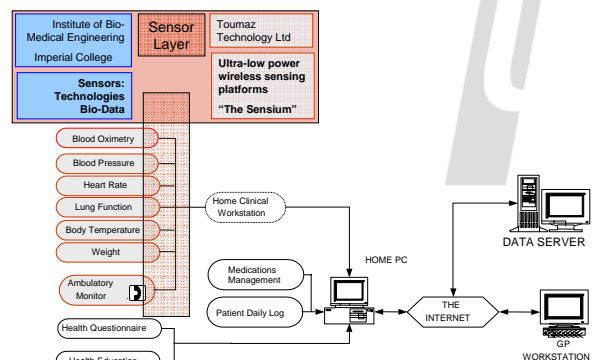
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Proactive Health Status Monitoring



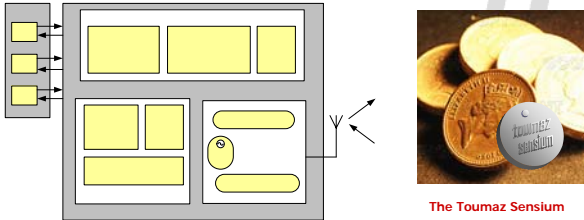
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Health Monitoring System Schematic



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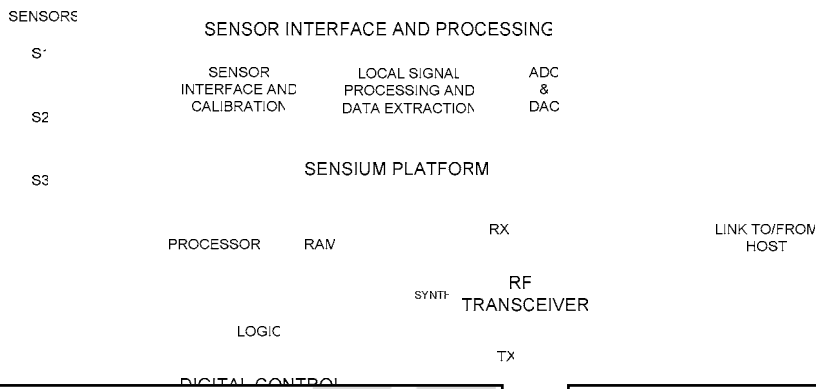
Sensor Node – The Sensium Platform



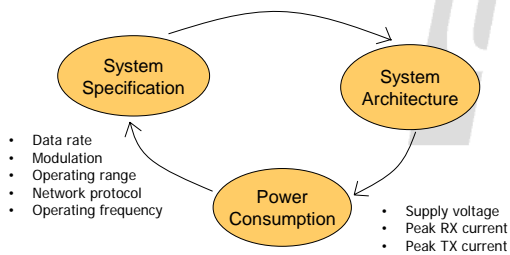
The Sensium - an ultra-low power platform for receiving and processing signals from chip-scale sensors, and providing wireless communications to/from a host.

Sensium Drivers for Health Status Monitoring

- Ultra low power
 - long battery life, using small (e.g. disposable, flat) batteries
- Smallest size – for wearable and implantable applications
- Ease of use – self-administration by patient
- Flexible – interface to a number of body-worn sensors
- Robust & fault tolerant – minimum external input required for calibration
- Low cost – particularly for 'disposable' applications



Sensium Wireless Platform: System Definition & Design



Power must become the main design criterion; relevant trade-offs must be identified and investigated.

Proprietary System or Defined Standard?

IEEE 802.15: Wireless Personal Area Networks (WPAN)

- 15.1 = Bluetooth (moderate data rate)
- 15.3 = UWB (high data rate)
- 15.4 = Zigbee (low data rate)

All current standards compromise power consumption for generality. No standard currently exists for wireless healthcare monitoring.

Which Operating Frequency?

- Available spectrum (ISM bands)
 - 433 MHz, 870/900 MHz, 2.4 GHz
- Antenna efficiency
 - Worst at 400 MHz, best at 2.4 GHz
- Path loss and body effects
 - Worst at 2.4 GHz, best at 400 MHz

700 - 900 MHz represents a good compromise for body-worn wireless sensor applications

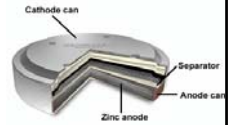


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Supply Voltage and Current?

Zinc-air batteries are preferred:

- Small and lightweight
- Long shelf life until opened
- Environmentally friendly (disposable)
- 1.4V dropping to 0.9V at end of life
- Peak currents must be limited to prevent battery 'collapse'



Target: 1 – 1.5 V and 3 mA



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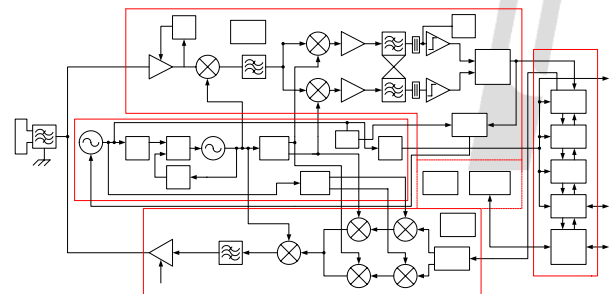
Sensium Transceiver Specifications for Body-Worn Applications

| Parameter | Value | Units |
|-------------------|-----------|-----------------|
| RX sensitivity | > -86 | dBm |
| RX noise figure | < 15 | dB |
| TX power | -10 | dBm |
| Data rate | 160 | kbps |
| Channel spacing | 300 | kHz |
| Modulation | GMSK | BT=0.4 |
| Supply voltage | 1.0-1.5 | V |
| Peak current | 3 | mA |
| Carrier frequency | 700 - 930 | MHz |
| Chip area | < 10 | mm ² |



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Sensium Transceiver System Architecture



Power consumption: 3 mA at 1V



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ISM Band Transceiver Performance Comparison

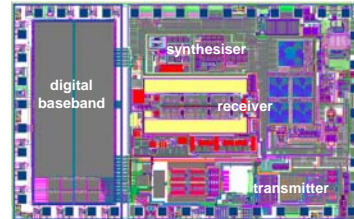
| | NORDIC VLSI | ANSEM | CHIPCON | AMIS | TOUMAZ |
|----------------------------|-------------|----------|-----------|----------|-----------------|
| Frequency Band | 2.4 GHz | 900 MHz | 2.4 GHz | 400 MHz | 900 MHz |
| Data Rate | 1 Mbps | 115 kbps | 250 kbps | 16 kbps | 160 kbps |
| Modulation | GFSK | 2-FSK | BPSK | ASK | GMSK |
| TX Current | 19 mA | 14 mA | 17 mA | 25 mA | 3 mA |
| RX Current | 25 mA | 19 mA | 20 mA | 7.5 mA | 3 mA |
| Voltage supply | 1.9 -3.6V | 2.7V | 2.1 -3.6V | 2.4-3.6V | 1-1.5V |
| Internal voltage regulator | Yes | No | Yes | Yes | Yes |
| Package size | 5x5mm | 6x6mm | 7x7mm | 5x5mm | 5x5mm |



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Transceiver Hardware Integration

- Spectrally efficient/power efficient digital modulation scheme.
- 1V operation for single zinc-air or solar cell operation.
- Minimum external components for miniature system size (2.5mm x 4mm)
- Submicron SiGe BICMOS process



Available
Q3 2005



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Sensium Wireless Platform Summary

- Focus on power as a major system parameter allows transceiver optimisation at specification, architecture, circuit topology and transistor level.
- Resulting 1V, 3mA transceiver has peak power typically 10x less than competing products.
- Next step: integration with sensor interface layer to create a complete Sensium for health status monitoring.



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