Wireless Sensor Networks for Structural Health Monitoring

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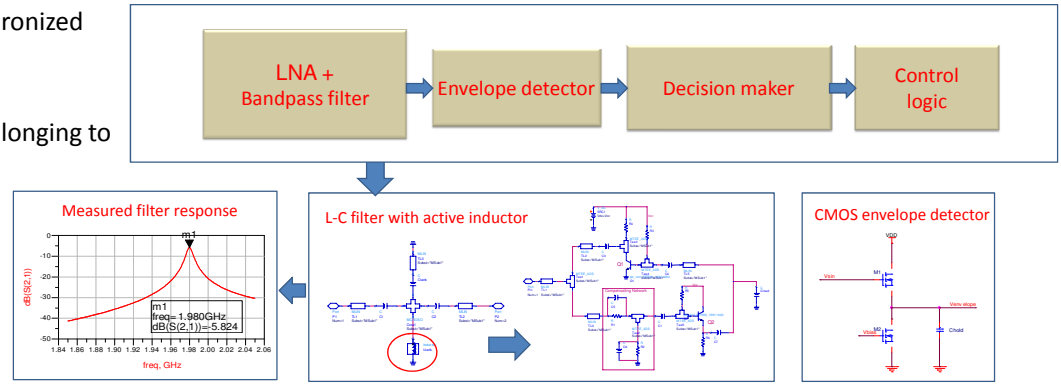
1. Wake-up radio architecture

The receiver is not phase synchronized with the transmitter

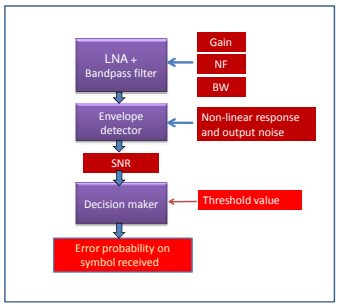
The wake-up signal is a tone belonging to the ZigBee standard channels



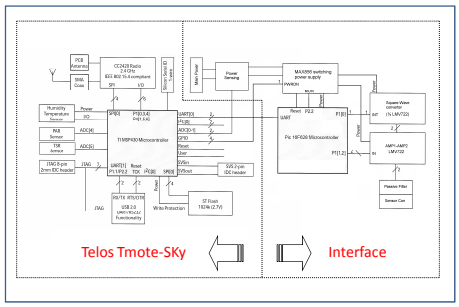
2. Wake-up radio Simulink model

The model allows performance estimation of the node, as a function of Gain, NF, Bandwidth

The decision maker calculates the error probability as a function of the output SNR

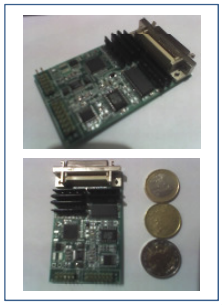


3. Interfaces with sensors



Improved interface with sensors

- 6 mechanical sensor input lines
- Wide power supply voltage range (CP approach) (1.5 – 24V)
- Improved analog sensor architecture (PLL based detection fundamental mode)
- Improved analog sensor implementation PAM amplitude
- Sleep mode available



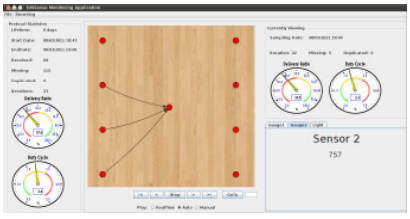
4.DISSense

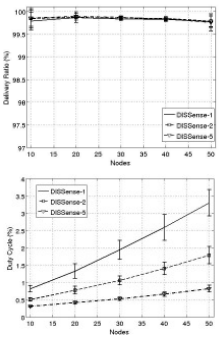
Ultra low-power communication protocol for Structural Health Moniroting

- Alternates short active phases and long sleep ones
- **Active phase** (100% duty cycle): guard time, resynchronization (sink-to-nodes) and data collection (nodes-to-sink)
- **Sleep phase** (0.1% duty-cycle): new nodes, out of synchronization management
- **Adaptive Engine**: collects statistics -> adapts the schedule -> minimizes the duty cycle
- **Implicit Backward Channel:** nodes-to-sink communication -> resynchronization, changes sampling periods, shares schedule
- **Collection Tree Protocol**: sink-to-nodes communication (Gnawali et al.) -> reliably collects data

Results:

- Ultra-low duty-cycle (<1% for 5min. Sampling period)
- High delivery rate (>99.5%)





5. EVONode 1030

Processor	**MSP430F6638**
CPU	RISC - 16 bit
Program Flash Memory	256KB
RAM	16KB+2KB
Supply Voltage Range	1.8 V to 3.6 V
USCI	2
Real-time clock module	1
DMA	1
RF Transceiver	**CC2520**
Transmit data rate	250 kbps
Frequency	2.4 GHz
Receiver sensitivity	-98 dBm
RF power (max)	5 dBm

Serial Memory Flash	**M25P32**
Memory	32 MB
Speed	75 MHz
Digital Humidity Sensor	**SHT75**
Energy Consumption	80uW
RH operating range	0-100% RH
T operating range	-40 - +125 ℃