Abstract

The overall objective of the project is to research wireless communication protocol options between the mobile nodes and to improve the reliability of the entire communication system while maintaining the already tight energy budget. Given the small dimension of the mobile bat nodes, new communication techniques are needed for connecting the mobile nodes to the stationary ground network. First, the communication among the mobile nodes needs to be designed keeping the energy budget and the hardware constraints into account. It is planned to develop a novel wake-up system in order to exchange node IDs as well as complete bat encounter information. In the best way, the node ID can already be encoded in the wake-up signal. Secondly, the robustness and reliability of the entire communication system needs to be improved without increasing the energy consumption. One approach is to exploit the spatial diversity of the radio signals from the mobile nodes that are received by multiple ground stations simultaneously. The aim is to use the ground network as a distributed and dynamic multi-antenna system that needs to be configured and maintained in a self-organizing manner.

Diversity Combining

- Multiple base stations receive a copy of the signal
- Combination of signals to increase packet reception rate
- Different combination strategies and levels of detail
- Real World experiments and simulation studies

<table>
<thead>
<tr>
<th>Forwarding Data as</th>
<th>Single Node (Mbit/s)</th>
<th>64 Nodes (Mbit/s)</th>
<th>Diversity Gain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complete signal</td>
<td>64</td>
<td>4096</td>
<td>Highest</td>
</tr>
<tr>
<td>Signal samples</td>
<td>3.07</td>
<td>196.6</td>
<td>High</td>
</tr>
<tr>
<td>Soft-Bits</td>
<td>0.31</td>
<td>19.66</td>
<td>Medium</td>
</tr>
<tr>
<td>Hard-Bits</td>
<td>0.01</td>
<td>0.61</td>
<td>Very low</td>
</tr>
</tbody>
</table>

Wake-Up Receiver

Energy Efficiency Communication

- Asynchronous low-power communication
- Applications in WSNs and IoT devices
- New matching circuit for dynamic addressing schemes
- Hardware prototypes and simulation studies

Demo

- SDR based Sender with GUI to determine wake-up mode
- Broadcast, Multicast and Unicast wake-ups
- Wake-up receiver prototypes indicating status via LEDs

Reliable Communication

Erasure Codes (EC)

- Communication using retransmissions prohibited
- Reliable Communication using Forward Error Correction

Demo

- 3 mobile nodes (TelosB) exchanging beacons
- Transmission of neighbour information using EC
- Distributed Data Storage using Virtual Cord Protocol (VCP)

Selected Publications


