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Fat-layer intra-body communication

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Summary

In this work, fat-layer intra-body communication (Fat-IBC) as an in-body wireless communication link, to provide a low-loss communication medium for implantable and wearable body networks (BAN), is explored. To reach a target 64 Mb/s in-body communication, IEEE 802.11 wireless communication at 2.45 GHz with low-cost Raspberry Pi single-board computers and external antennas was used. The human body was emulated by phantoms of different lengths and measured in a shielded chamber to confine the signals to the fat layer of the phantoms. Using in-body (implanted) and on-body (on the skin) antenna combinations, the link was characterized using scattering parameters, Bit-Error-Rate (BER) vs. SNR with different modulation schemes, and WLAN communication.
The loss of the fat-layer link is 1 dB/cm. For all antenna combinations, link speeds of 90 Mb/s were achieved using 2.45 GHz 802.11n with 40 MHz bandwidth. The speed is limited by the radio circuits, not the fat-layer link. The results show that Fat-IBC, using low-cost off-the-shelf hardware and established IEEE 802.11 wireless communication, can achieve high-speed data communication within the body. The obtained data rate is among the fastest measured within a human body.

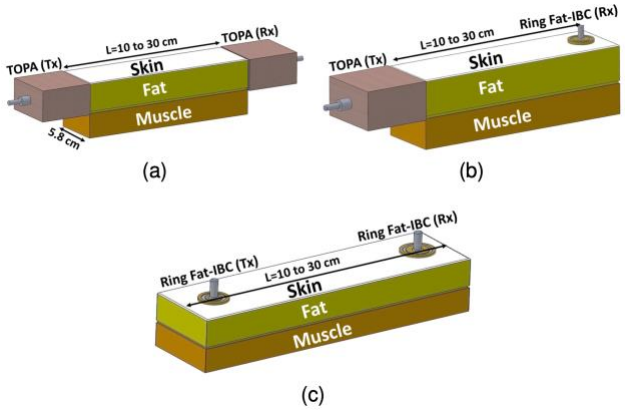

Figure 1. Antenna connections to the phantoms: (a) Implant-to-Implant antennas, (b) Implant to On-body antennas, (c) On-body to On-body antennas.

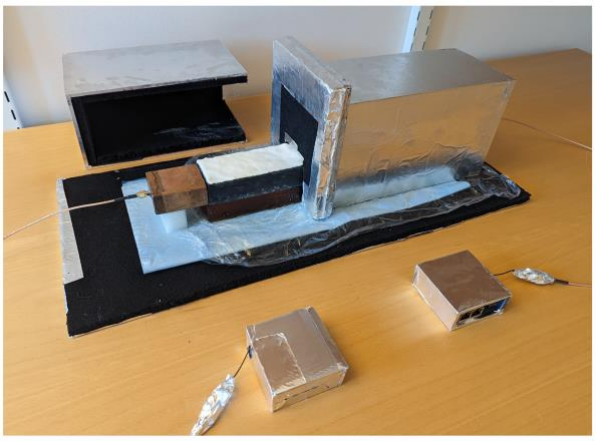

Figure 2. The shielded chamber with one chamber segment removed, exposing the three-layer phantom and topology-optimized planar antenna inside. In front are the two Raspberry Pis inside aluminum-clad cases**.**

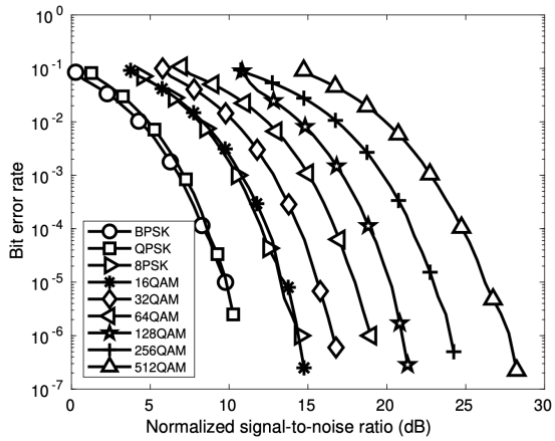

Figure 3. BER vs. E_b/N_0 for different modulations schemes.

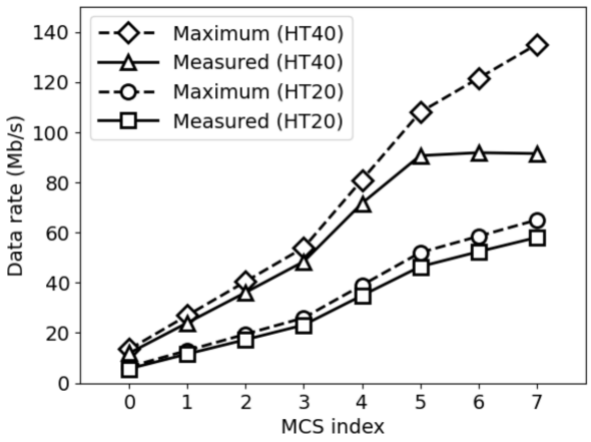

Figure 4. Date rate vs. MCS index for bandwidths of 20 MHz and 40 MHz.