**Subject:** Response to comments from ISO/IEC JTC 1/SC 6 with respect to Submission of IEEE Std 802.15.6™-2012 for fast-track adoption under the ISO/IEEE PSDO Agreement

**Reference:** ISO/IEC JTC 1/SC 6 Document Number 6N16508, 2016-11-25.

**Summary:** We received 5 comments total: there were 3 comments provided for which a response can be provided. There were 2 comments stating the vote of the voter on the questions, for which no response is presented in this document. Comments GB3 (003), DE (004), and JP1 (005) are addressed.

The three comments were substantially the same. All three comments are directed at Clause 10, the Human Body Communication (HBC) Physical Layer (PHY). Specifically concern is expressed at the coexistence properties of the HBC PHY when operated in proximity to the Close Capacitive Coupling Communication Physical Layer (CCCC PHY) defined in ISO/IEC 17982:2012. All three comments request investigation regarding interference potential between the two systems.

**Response:** We examined the features and characteristics of the 802.15.6-2012 HBC PHY and the PHY defined in ISO/IEC 17982:2012.

* **Channel access in 802.15.6:** Two methods are defined in the MAC layer: CSMA/CA and Slotted-ALOHA. When implementing the HBC PHY (clause 10), use of Slotted-ALOHA is defined in the standard. The design factor for the use of Slotted-ALOHA is the expected very low duty cycle operation and the extremely limited sphere of influence of a device in a Body Area Network (BAN). Classical analysis shows that collisions rates are as low or lower using ALOHA when duty cycle is less than 18%.
* **Duty cycle:** In uses intended for HBC, the expected duty cycle is far lower. The design of slotted-ALOHA as defined in 802.15.6 (clause 7) restricts duty cycle by the timing required. For the expected duty cycle, interference mitigation via slotted-ALOHA is probabilistically equivalent or more effective than LBT.
* **Transmit power:** The maximum transmitted energy allowed by the standard is low. This is required to ensure safety as the medium is the surface of the human body. The medium (the human body) tends to limit radiated emission further. The transmit spectral mask for the HBC PHY further restricts power outside of the 21 MHz band.
* **Frequency separation:** The band of operation defined for the HBC PHY is centered at 21 MHz with the 3dB signal bandwidth of 5.25 MHz.. The band of operation defined in ISO/IEC 17982:2012 CCCC PHY center frequency fc is 40.68 MHz. According to the transmit spectral mask defined for the HBC PHY in 802.15.6-2012, the signal level is at most -20dB below the maximum spectral density of the transmitted signal. Using the maximum transmit power, spectral mask and frequency separation, an HBC signal at the transmit electrodes would appear less than -85 dBm. Note also the HBC signal modulation uses spreading codes which mitigates spectral impact further. Additionally the standard requires HBC devices to limit their transmit power to mitigate against interference to other devices and systems, to protect the safety for the human body, and to meet local regulatory policies, which will result in practical implementations typically operating well below the maximum power defined in the standard.

The transmit power limitation and frequency separation ensure that the two PHYs can coexist so no additional interference avoidance mechanism is needed.