# Project: IEEE P802.15 Working Group for Wireless Personal Area Networks (WPANs)

**Submission Title:** assigned comments for sponsor ballot
**Date Submitted:** January 2011
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**Re:**

**Abstract:** proposes comment resolutions for a set of sponsor ballot comments

**Purpose:**

# Comment 29

## Issue

- For band division, another additional novel metric should be used for visible light band division, namely the photo detection responsivity. By using the photo detection responsivity of the receiver device rather than the currently existing metric of the third party (not participating in communication), i.e., human's eye sensitivity, we achieve higher rate performance and more reliable communication, i.e., lower error rates, resulting in approximately 0.05dB rate spectral efficiency gain, or more than 1.1% rate spectral efficiency gain. More importantly, fairness is a key parameter for wireless communications. This division enhances this fairness. The whole band should be divided so that all bands have equal Eb/No value for all subbands and thus results in fairness for all users. Furthermore, simulation shows the superiority of the band division using photo detection responsivity over the band division method using human eye sensitivity. This new division improves reliability performance in a multi-channel environment since it enables a VLC transmitter to maintain a constant transmission range and make the communication link more robust by avoiding a significantly different communication capacity for each subband. While the Eb/No performance varies with respect to the deployed subband (as much as 3.43dB, or more than 2.2 times, difference) using the currently existing band plan, the new plan yields equal performance for all the subbands. Thus the proposed plan ensures fairness among channels (or subbands). Refer to 15-10-0327-00 for more detailed evaluation with simulation results.

  Simple change of some numbers will improve the performance and fairness.

## Suggested remedy

- Simply change six numbers in wavelength column and seven numbers in spectral width column in Table 75 as 450 to 478, 510 to 540, 560 to 588, 600 to 633, 650 to 679, 710 to 726 and 70 to 98, 60 to 62, 50 to 48, 40 to 45, 50 to 46, 60 to 47, 70 to 54. And add two words, "photo detectors" after "human eye" in lines 45 and 47 and change "is" to "are" in line 47.

# Discussion

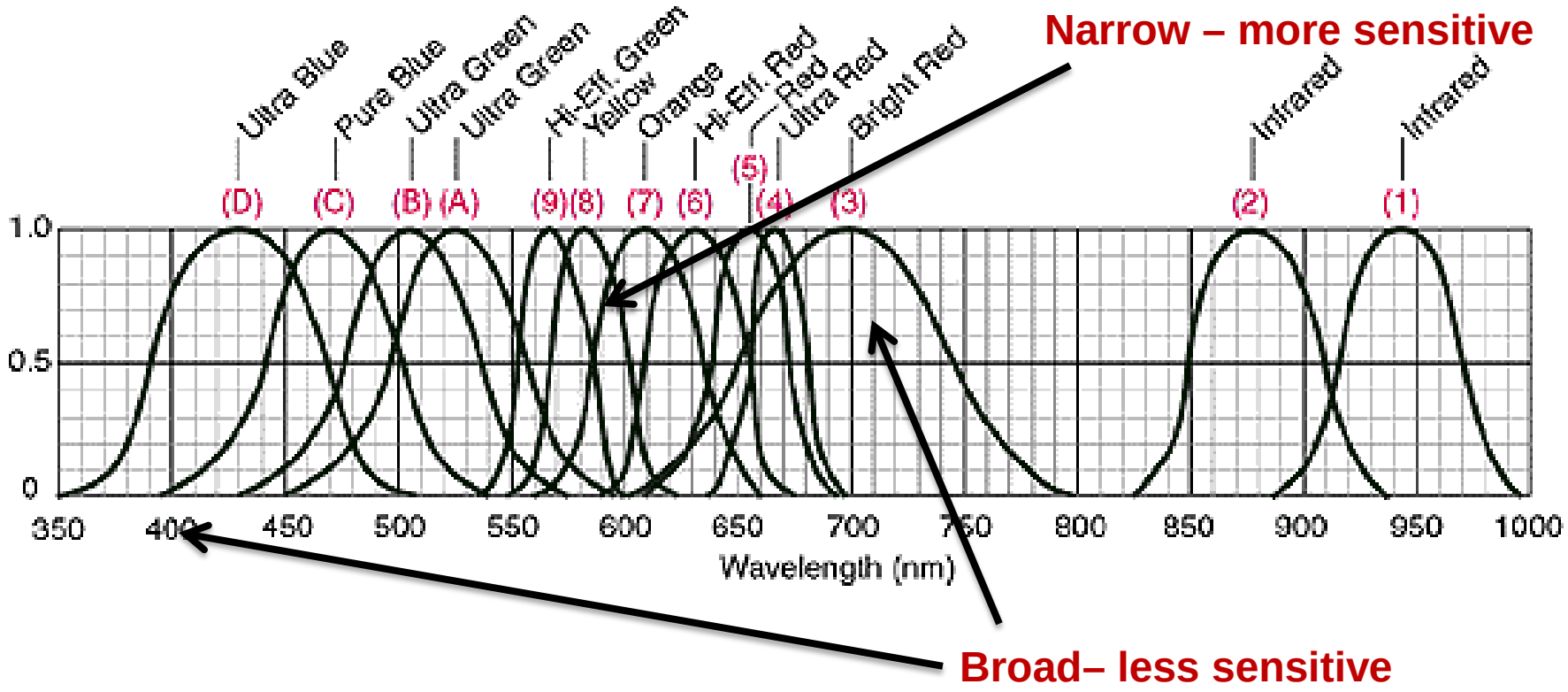
Communication systems and standards are designed based on transmitter specifications and characteristics, which in our case are typically LEDs.

LEDs are primarily designed for illumination based on color and human eye sensitivity to color.

- Communication is a secondary function

# Typical LED frequency response in the visible spectrum

***Source:*** ***http://www.oksolar.com/images/led_tech-gi-1.gif***



# Additional points for discussion

Although we have 7 bands in the bandplan, most applications will choose probably in the range of 1 to 3 colors for communication and the color choice will not be based on performance optimization for communication, but for illumination, such as traffic lights.

Hence, since most applications will be using LEDs based on the color and availability and not all 7 color bands will be typically supported, considerations such as fairness for communication on all bands is not an issue

The standard also supports channel aggregation in order to accommodate LEDs of various bandwidths and center frequencies

# Suggested recommendation for comment 29

Consider bandplan based on current LED transmit characteristics and hence, keep the current bandplan structure

- Wider bands at the edges, narrower at the center

Accept the part about “ and add two words, "photo detectors" after "human eye" in lines 45 and 47 and change "is" to "are" in line 47.”

# Comment 94

## Clarify sentence

- In addition, all PHY III devices should match the operating optical frequency bands for communication so that transmission on two optical frequency bands do not fall within one optical filter band of the receiver.

# Discussion

For CSK operation, the Tx of device 1 and Rx of device 2 must support the same frequency bands.

However, we do not specify Rx in the standard.

Hence, the way we enforce this is that we ensure the transmitter and receiver in a device support the same bands i.e. if I can transmit CSK on R, G, B, I can receive CSK on R, G, B

Hence, if device 1 and device 2 have the same bandplan in their capabilities IE for CSK, they can communicate with each other

# Suggested resolution

## Change the text to the following

- In addition, PHY III devices should exchange their supported bands for CSK operation and verify that the frequency bands supported in all PHY III devices in the network support reliable CSK communication. This is to ensure that transmission on two optical frequency bands of the transmitting device does not fall within one optical filter band of the receiving device for CSK operation, leading to communication errors during CSK operation.