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Federal Communications Commission
7435 Oakland Mills Road
Columbia, MD 21046

Ref: GRIDLOCK Maximum Duty Cycle over a 100 ms window

Dear Examiner,

The GRIDLOCK system utilizes two separate radio transceivers, each of which operate on a TDMA time schedule consisting of a continuous sequence of a minimum of 7.25 ms timeslots. The two transceivers (one in the 915MHz band and one in the 2.4GHz band) operate slightly differently.

2.4GHz transceiver

For the 2.4GHz transceiver, in each timestlot the radio will do one of the following:

1) Remain inactive
2) Transmit a packet and potentially receive and acknowledge
3) Potentially receive a packet and transmit an acknowledge

When transmitting a packet, transmission duration is a function of the payload, with a maximum of up to 128 bytes. When receive a packet the transmitted acknowledgment will be a maximum of 27 bytes. During network operation radios receive three times for every transmit slot, and as a result the maximum possible duty cycle is created with the following sequence:

1) Transmit
2) Acknowledge
3) Acknowledge
4) Acknowledge
5) Transmit
6) Acknowledge
7) Acknowledge
8) Acknowledge
9) Transmit
10) Acknowledge
11) Acknowledge
12) Acknowledge
13) Transmit

A radio transmit consists of 4 stages:

1) Initialization: radio is prepared for transmit (transmitter is off)
2) Ramp up: transmitter is ramped to peak power
3) Transmit: from 0 to 128 bytes of data maximum + 5 bytes preamble/SFD
4) Ramp down: radio transmitter is turned off

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Where the data rate is 250 kbps +/- 40 ppm, or 32 us/byte.

Ramp up and ramp down of the takes 77 us. Given the frequency of the messages the maximum duty time the radio can be transmitting over a 100 ms is:

Max Tx on = 4*Transmit[128 bytes] + 9*Acknowledge
= 4*[(128+5)*32us + 77us] + 9*[(27+5)*32us + 77us]
= 4*[4.333 ms] + 9*1.101 ms]
= 27.241 ms

Max Tx duty cycle is therefore:

= 27.241 ms on / 100 ms
= 27.241 %

915MHz transceiver

For the 915MHz transceiver, in each timestlot the radio will do one of the following:

1) Remain inactive
2) Transmit a packet
3) Potentially receive a packet

When transmitting a packet, transmission duration fixed at 0.896 ms, which corresponds to a 28 byte packet sent at 250 kbps. The maximum possible duty cycle is obtained by transmitting in every timeslot. The maximum duty cycle is then:

Max Tx duty cycle = 0.896 ms on / 7.25 ms
= 12.359 %

Sincerely yours,

David Mayhew
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