SuperCom - PureOne Device
Analysis and Design of Cellular/BLE Duty Cycle

Contents

Purpose

- Analyze and demonstrate the cellular and BLE Tx duty factor.
- Describe all reasonable and infrequent use cases.
- Show how the design inherently provides protection from alterations of the maximum duty factor that was considered for compliance purposes.

Device details

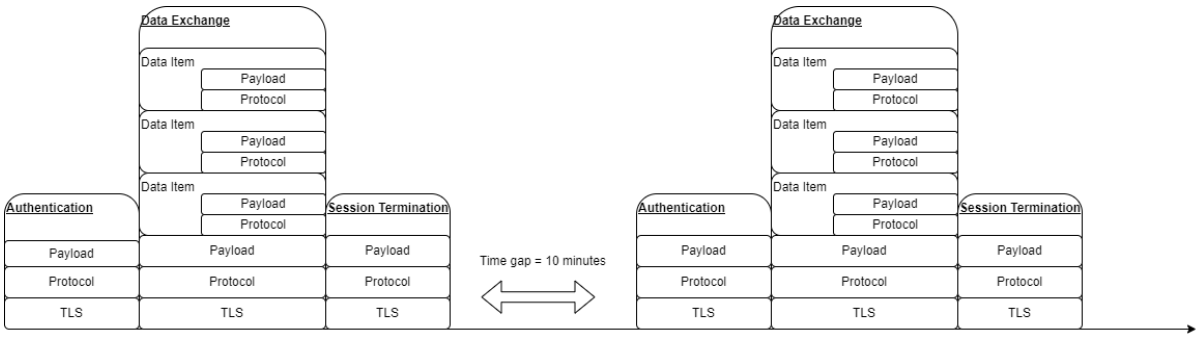
Product:	PureOne
Manufacturer:	SuperCom LTD
Model:	PureOne
Hardware Version:	3.0
FCC ID:	2BAX3PRFPUREONE30

Device Tx Data Analysis

Cellular Data Tx Flow

- Communication interval
  - Infrequent: every 60 minutes, usually when at home.
  - Frequent: every 10 minutes, usually when outside home.
- Communication session flow:
  - Authentication and security
  - Data exchange
  - Session termination

Data payload analysis:

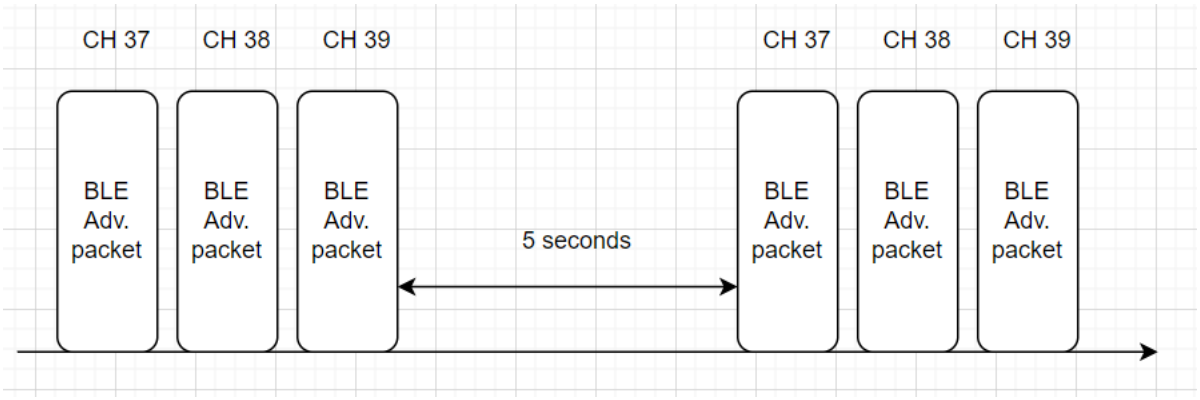


Data payload is up to **2060 bytes** per session, according to the following analysis:

- Authentication and security – **600 bytes**
  - TLS/SSL negotiation: 200 bytes
  - HTTP headers and structure: 180 bytes
  - Protocol overhead data: 100 bytes
  - Authentication net payload: 120 bytes
- Data exchange – **1100 bytes**
  - Security overhead – 80 bytes
  - HTTP headers and structure: 180 bytes
  - Other overhead data: 100 bytes
  - Data items size: 640 byes
    - Single data item size: 32 bytes
    - Protocol overhead data: 32 bytes
    - Number of data items: 10
- Session termination– **360 bytes**
  - Security overhead – 80 bytes
  - HTTP headers and structure: 180 bytes
  - Protocol overhead data: 40 bytes
  - Termination net payload: 60 bytes

Standard Active Transmission Time

BLE Tx schematics



- 2060 bytes payload in bits
  - 2060 X 8 = 16,480
- Data rate: assuming 5 Mbps (using LTE network connection)
- Calculation:
  - 16,480 / 5 = 3.296 milliseconds

The active transmission time is a time slot of 10 minutes is 3.296 milliseconds.
Duty Cycle = (3.296 milliseconds / 600,000 milliseconds) * 100 **= 0.05493%**

The standard typical duty cycle is: **0.05493%**

Description of reasonable and infrequent cases- Cellular

There are 3 use cases:

1. Standard reporting.
   a. Device is active, not at home, communications is every 10 minutes.
   b. Duty cycle is **0.05493%**
2. Infrequent reporting.
   a. Device is active, at home or static position/location, communications is every 60 minutes.
   b. Duty cycle is **0.00915%**
3. Alarm reporting.
   a. A special case where a single alarm/data should be immediately sent.
   b. Maximum allowed alarms per day: 20 alarms

Duty cycle at worst case scenario:
Assumptions:

- Standard reporting mode is active all the time.
  - Communication is every 10 minutes.
  - Payload per session: 2060 bytes

- Daily payload:
  - 1440 minutes / 10 minutes X 2060 bytes
  - Daily payload: **296,640 bytes**
- Device is triggering 20 alarms per day.
  - Each alarm payload: 2060 bytes
  - Daily alarms payload: 2060 * 20 = **41,200 bytes**
- Total daily payload: 296,640 + 41,200 = **337,840 bytes**

Daily Payload in bits: 337,840 * 8 = 2,702,720 bits
Tx time, assuming data rate of 5Mbps: 2,702,720 / 5 = 540,544 milliseconds
Daily Duty Cycle = (540,544 milliseconds / 86,400,000 daily milliseconds) * 100 = 0.6267%

The maximum daily Tx duty cycle is 0.6267%.

Bluetooth duty cycle analysis

The PureOne device uses a "Bluetooth low energy" certified module.
The device is set up to transmit status data every 5 seconds.
The protocol is "Advertising" (broadcast) under GAP profile.
Protocol characteristics:

- Data rate: 1 Mbps
- Interval: 5 seconds
- Channels: All 3 channels used (channels: 37,38,39)
- Payload: 39 bytes

Standard Active Transmission Time

Payload in bits: 39 (bytes) * 8 = 312 bits
Daily packets: 86400 / 5 = 17,280
All 3 BLE channels: 17,280 * 3 = 51,840

51,880 / 1 (Mbps) = 51.88 milliseconds

Duty cycle: 51.88 / 86,400,000 = 0.00006 %

The BLE duty cycle is 0.00006 %

Description of reasonable and infrequent cases

The BLE advertising protocol uses a random time before/after each 5 seconds Tx interval.
The average of 5 seconds interval is still being kept.

System design to protect from duty cycle alterations.

Standard design

The PureOne device is a hardware-based device. The hardware was designed, reviewed, implemented, and manufactured using standard design tool and by professional engineers.
During manufacturing, each single device is being tested and documented for quality control.
The radio hardware component are certified.
During development process, intensive QA and external Labs are used for verifications.

Design to meet and keep requirements:

To meet duty cycle requirements, and keep up with them:

- Device has a precise real time clock for timing.
    - Time is constantly being verified against a server to avoid any drift.
- Device has flash and eeprom memory to keep track of all communication intervals and data payload history.
- RF modules are certified and by know vendors.
- Product is being tested at RF labs.
- Product is reporting its Tx statistics for analysis and record keeping.