SAFECAST - POINTCAST V1.0

Revision:

1.0 - April 2015
- first draft

1.0.1
- incorporated feedback on 1.0 draft

1.0.2
- include additional stats under STATS window (1.15)
- include parameter for setting the integration window (3.10) (1.6)
- add parameter for setting the upload window (e.g. integration window and upload window don't need to be the same) - (3.10) (1.6)
- add counter for number of resets, uptime (1.15)
- add deadtime correction (3.9)

1.0.3
- small changes to 1.1 layout
- 1.2 screen layout and logic for BAT/EXT power mode detection

1.0.4
- move SDCARD screen before TIME screen
- NGEIGIE.TXT renamed to PNTCAST.TXT
- all screens to 5s
- changed SD log format

1.0.5
- joystick down on startup, 1 second screen display till "API" screen.
- joystick enter(push center button) clears eeprom on startup and clear alarm button on main screen.

1.0.6
- Time setup automatically for GMT (later need to be modified for timezones)
- SDcard added option for 5 seconds upload for testing/trouble shooting (trb=1)

1.0.7
- Handling of MAC

1.08
- FAILS handling

1.1 Functions Shield

- triple input - dual geiger tube input (S1,S2) + one aux input (AUX)
- float/pull up/pull down 47k for each input line
- bypass coupling caps for each input line
- LED monitoring of 2 geiger input lines (analog circuit)
- Green LED -- heartbeat
- Red LED -- alarm / error condition
- Reset button
- Joy stick for screen operation
- Digital Temperature sensor
- Alarm Buzzer
- 20x4 LCD interface (dimmable)

1.2 Functions Mother Board

- Main controller - Teensy
- Data Logger (SD card)
- System Setup (SD Card)
- Power supply -- USB, External, Battery (3.3 / 5v)
- Battery charge status (analog input)
- Ethernet Interface (optional)
- 3G Interface (optional)
- Xbee Interface for BLE or Wifi (optional)

1.3. SD Card files

- PNTCAST.TXT - system setup
- SENSORS.TXT - sensors setup
- NETWORK.TXT - communication setup
- CONFIG.TXT - data logger setup (fixed)
- XXXXXXXX.LOG - historical logs (one file per day)
- BUFFER.TXT - measurements not uploaded successfully

2. SCREEN FLOW

1.1 Startup Screen (5s)

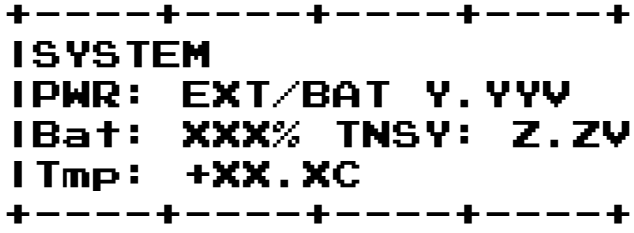
Procedures:

- RED/GREEN LED ON (test)
- Buzzer ON
- Read Device ID from flash memory - this is the fixed serial number for the POINTCAST (this can be set from SD card)
- INTERUPT: Joy stick enter CLEAR EEPROM settings
- INTERUPT: Joy stick DOWN (close screen within 5s timer and other setup screens 1 second display only)

1.2 System Status (5s)

Procedures:

- read PWR status:
  - BAT <4.5v
  - EXT >4.5v
- Main power voltage Y.YYV
- Bat% (if in BAT mode) based on Nano algo
- Pointcast Internal Power Z.ZV
- read Tmp sensor (now setup to be send as deviceID+8)



1.3 Read SD Card files (5s)

Procedures:

- Read PNTCAST.TXT and set flash memory

- Read NETWORK.TXT and set flash memoryRead SENSORS.TXT and set flash memory
- If no SD card, then load defaults or use past values set.

⇒ Possible to read name of SDcard and bytes left?
⇒ Show Fail reason?

```
+----+----+----+----+
|SDCARD FAIL/PASS XXXMB
|PNTCAST: FAIL/PASS
|SENSORS: FAIL/PASS
|NETWORK: FAIL/PASS
+----+----+----+----+
```

1.4 Time (5s)

Procedures:
- Read time from RTC
- Read time zone from flash memory (Can be set by PNTCAST.TXT)
- Adjust time by time zone (setup for UTC)
- INTERUPT: Joy stick PUSH (to enter Time Setup screen)
- INTERUPT: Joy stick DOWN (close screen within 5s timer)

```
+----+----+----+----+
|TIME (GMT)
|Date: YYYY/MM/DD
|Time: HH:MM:SS
|Zone: +9
+----+----+----+----+
```

1.5 Set Time (5s)
does n
This screen should be after network test has been done, so there's confirmation there's a network. In case of no network, RTC will be used, with option to use joystick to adjust the RTC. If network is available, attempt will be made to use pool.ntp.org for setting the time. If NTP fails, use RTC, with option to change it (so wait additional 5 seconds for setup)

Time should be set in GMT. Display to show local time.

If RTC is not set manually or by NTP, timestamp to be flagged "invalid". Some thinking needed how to use RTC when on battery. So check what RTC is when cold boot happens - if detected it's "not set", flag as invalid, till RTC or manually set has been performed.

Procedures:

- Read time from RTC
- Read time zone from flash memory (Can be set by PNTCAST.TXT)
- Adjust time by time zone
- INTERUPT: Joy stick:
    - Up/Down - increase/decrease field
    - Left/Right - move prev/next field
    - Center - Set and Close screen

- Display on screen if NTP server connected or not

```
+----+----+----+----+
|RTC check...
|
|please wait a couple
|seconds...
+----+----+----+----+

succeed:
+----+----+----+----+
|NTP server:
|45.79.78.173
|
|time:
+----+----+----+----+

fail
+----+----+----+----+
|
|
|
|
+----+----+----+----+
```

1.6 POINTCAST parameters (5s)

Procedures:

- read parameters from flash
- INTERUPT: Joy stick DOWN (close screen within 5s timer)

```
+----+----+----+----+
|POINTCAST SETUP
|DeviceID: XXXX
|TimeZone: -9
|ALARM-S1: 150 CPM
+----+----+----+----+

+----+----+----+----+
|UPLOAD MODE
|Adaptive: OFF
|Integr Win: 300sec
|Upload Win: 300sec
+----+----+----+----+
```

1.7 GPS location (5s)

Procedures:

- read parameters from flash
- INTERUPT: Joy stick DOWN (close screen within 5s timer)

⇒ Option -- offer function to edit location or read from GPS module

```
+----+----+----+----+
|GPS LOCATION
|Lon: 12.3456
|Lan: 12.3456
|Alt: 100m
+----+----+----+----+
```

1.8 SENSORS parameters (3s)

Procedures:

- read parameters from flash
- INTERRUPT: Joy stick DOWN (close screen within 5s timer)
- Leave Aux for now, just show NC
- INTERUPT: Joy stick DOWN (close screen within 5s timer)

```
+----+----+----+----+
|SENSORS SINGLE/DUAL
|S1=334 CPM/uSv Cs137
```

```
|S2=120 CPM/uSv Cs137
|AUX=NC
+----+----+----+----+
```

1.9 SENSORS test/auto detect sensors (max 60 sec)

Procedures:

- read pulse from S1 - if no pulse in 30sec, then FAIL. PASS on first pulse
- read pulse from S2 - if no pulse in 30sec, then FAIL. PASS on first pulse
- based on result, update sensor config
- INTERRUPT: Joy stick DOWN (close screen within 5s timer)

⇒ Theoretically time out can be set based on the CPM for each sensor - bit academic

```
+----+----+----+----+
|SENSOR TEST
|S1=PASS/FAIL
|S2=PASS/FAIL
|AUX=NC
+----+----+----+----+
```

1.9 API parameters (5s)

Procedures:

- read parameters from flash
- INTERRUPT: Joy stick DOWN (close screen within 5s timer)
- Leave Aux for now
- Display full API key (20 chars, no need for “API-KEY” label)

```
+----+----+----+----+
|API
|S1-ID=XXXX
|S2-ID=YYYY
|sdffkDSFsdkj
+----+----+----+----+
```

1.10 NETWORK configuration (5s)

Procedures:

- read parameters from flash (read which network interface is selected)
- read NIC/IP/GW from Ethernet or Wifi
- read other stuff from 3G like signal strength, carrier, phone number, etc

- read NIC from BLE
- INTERRUPT: Joy stick DOWN (close screen within 5s timer)
- Show top line first, before starting network status check. If time out, show: No LAN detected and wait for 5s

```
+----+----+----+----+
|NETWORK ETHER (DHCP)
|IP: AAA.BBB.CCC.DDD
|GW: AAA.BBB.CCC.DDD
|ID NN:NN:NN:NN:NN:NN
+----+----+----+----+

+----+----+----+----+
|NETWORK WIFI (DHCP)
|IP: AAA.BBB.CCC.DDD
|GW: AAA.BBB.CCC.DDD
|ID NN:NN:NN:NN:NN:NN
+----+----+----+----+

+----+----+----+----+
|NETWORK 3G
|Signal: |ooooo|
|Carrier: NTT Docomo
|GW: AAA.BBB.CCC.DDD
+----+----+----+----+

+----+----+----+----+
|NETWORK BLE
|
|
|
+----+----+----+----+
```

ID - MAC-Address

- if not available from the interface API, show value read from EEPROM
- in SD card, parameter for MAC is “macid” that will be stored in EEPROM upon reading the SDcard.

1.11 NETWORK test (5s)

Procedures:

- initialize Network Interface (Ethernet/3G/BLE/WIFI)
- connect to api.safecast.org/gateways -- check if Internet is available and if Safecast GW is reachable.. V3.6.7 checks http://api.safecast.org for redirect to https and returns a 301. If successful flags the connection as valid.
- if fail, try twice if not, reset and startup with random GW
- RED LED if fail. on next time of PASS RED LED will be reset
- INTERRUPT: Joy switch DOWN (close screen within 5s timer)
- Joy switch to right will ping the api and will pause the progress. Next screen will happen on joy switch down.

⇒ For Ether, 3G, Wifi, BLE sleep interface after test

```
+----+----+----+----+
INETWORK TEST (ETHER/3G/BLE/WIFI)
IDevice: PASS/FAIL
IGW: AAA.BBB.CCC.DDD
IPing : PASS/FAIL
+----+----+----+----+
```

1.12 YYYYMMDD.LOG creation (5s)

Procedures:

- Create or append to Log file
- Read NETWORK.TXT and set flash memory
- Read SENSORS.TXT and set flash memory
- If no SD card, then load defaults or use past values set.

⇒ Possible to read name of SDcard and bytes left?
⇒ Show Fail reason? In terminal screen

```
+----+----+----+----+
IDATA LOGGER
IYYYYMMDD.LOG: NEW/FAIL
IXXXX MB Free
I
+----+----+----+----+
```

1.13 Main Loop Screen

Procedures:

- RED LED ON IF Upload Fail OR CPM-S1=0 OR CPM-S2=0 OR ALARM = TRUE
- RED LED ON if S1 >> S2 in uSv/h (or other way around - factor 3)
- GREEN LED ON if RED LED = FALSE (if possible, shortly blink every 10 sec)

- *If upload fails, show FAIL(n) where n is number of measurements in buffer*
    - FAILS show how many retries left in 3G
    - FAILS on Ethernet show which sensor send data is failing
- STS -- show remaining seconds to next upload and Antenna Strength. In case on Battery, show battery left%. Refresh every 10 seconds.
- STS -- use for any additional detail in case of a RED LED (e.g. “ALPHA/BETA!”, “SPIKE!”, “S1 FAIL”, “BAT LOW”)
- LOG - show time in local time zone (no summer time adjust!)
- INTERRUPT - Joy-stick UP button - scroll through all Setup pages
- INTERRUPT - Joy-stick DOWN button - scroll through Stat pages
- INTERRUPT - Joy-stick LEFT button - show terminal screen 1.14
- INTERRUPT - Joy-stick RIGHT button - show Antenna Strength screen (refresh every 1s for quick response)
- INTERRUPT - RESET button - hard reset system

```
+----+----+----+----+
|S1=9999 CPM m.mm uSh
|S2=10.1kCPM mmmm uSh
|API: HH:MM PASS/FAIL(nnn)
|STS: OK 4:50 |ooooo|
+----+----+----+----+
```

- For the first sample, show following status (and show measurements as 0)

```
|API: HH:MM Startup..
```

1.14 Terminal screen

```
+----+----+----+----+
|TERMINAL
|res=z1
|res2=
|
+----+----+----+----+
```

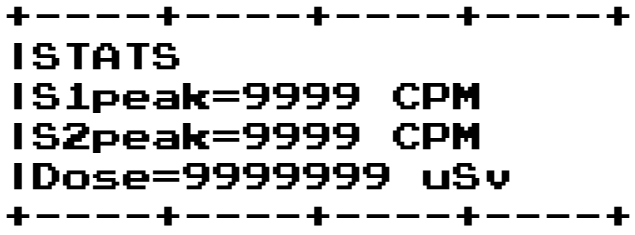
Simple screen to live show the output to LPR for in the field trouble shooting. (kind of verbose mode)

1.15 Stat screens

Procedures:

- Scroll through automatically, each screen 10s, then return to 1.13
- INTERRUPT - Joy-stick DOWN button - stat 2
- INTERRUPT - Joy-stick UP button - goto return to 1.13

Stat-1



Stat-2:

Procedures:

- INTERRUPT - Joy-stick UP button - goto Stat-1 page
- INTERRUPT - Joy-stick Down button - return to 1.13

3. DESIGN NOTES

3.1 Adaptive Logging

- when radiation levels change by x %, log radiation every y seconds instead of t seconds

3.2 Periodic reset -- DONE

- based on rst parameter, hard reset Pointcast every x
- resets every saturday

3.3 Battery low power mode

- shutdown display and network subsystems - log to BUFFER.TXT file instead

3.4 SD CARD management -- DONE

- create new file for each day YYYYDDMM.TXT
- how to handle full SD card TBD ⇒ Reality is to fill 4GB card it will take 10's of years.

3.5 Log buffer (buffer.txt)

- when upload fails, append failed measurements to BUFFER.TXT, increase BUF counter
- retry - if succeeds, upload all from BUF. Set BUF counter to zero when complete. If fails, continue with next measurement

3.6 Dev mode (network.txt) -- DONE

- dev parameter flips between dev and prod servers (retaining all other parameters for seamless promotion of a sensor after test to deployment.

3.7 Set RTC from NTP server (option) -- DONE

3.8 Wifi

- build around Wifi bee module -setting of network to be done over Wifi and no need for parameters to setup the module at this point

3.9 Deadtime correction

- apply deadtime correction to CPM values before upload
- formula:

```
c_p_m = (unsigned long)((float)c_p_m/(1-(((float)c_p_m*1.8833e-6))));
```

3.10 Integration and Upload window

- integration window (in seconds)
- upload window (in seconds)
- capability to set the integration window based on the sensor sensitivity
- capability to upload data on the same or slower pace as the integration window
- these mode may be overwritten by the adaptive upload method, where updates are based on change rather than interval (3.1)
-

4. GATEWAY/API

See:

https://docs.google.com/document/d/1ZxJI0ODhpgQ0rvSRrRyq1NAwyiliyxd7bJkL8JX76e8/edit

5. SD CARD FILE FORMATS

5.1 PNTCAST.TXT

```
devid=XXXX      #unique Pointcast DeviceID
lat=34.482597   #latitude
lon=136.163349  #longitude
alt=100         #altitude in meters
tws=300         #integration window in seconds
ups=300         #upload window in seconds tws <= ups
autow=1         #auto adaptive window for sudden changes
rst=0           #periodic reset in days (0 is OFF)
alm=150         #alarm for S1 sensor in CPM
tz=+9           #timezone adjust (0 is GMT)
trb=0           #switch to 5 seconds update mode for troubleshooting
```

5.2 NETWORK.TXT

```
intf=EN/3G/BT/WF #interface selection: EtherNet 3G BlueTooth WiFi
macid=xx.xx.xx.xx.xx.xx # MAC-Address for Ethernet cards.
uid1=nnnn        # API ID for upload of data from S1 sensor
uid2=nnnn        # API ID for upload of data from S2 sensor
devt1=nnnn       # API device type sensor 1 LND7317 (129) LND712(130)
devt2=nnnn       # API device type sensor 2 LND7317 (129) LND712(130)
api=AzQLKPwQqkyCTDGZHSdy #20 char api key          # API for Pointcast
gw01=107.161.164.166                              # Gateway 01
gw02=107.161.164.163                              # Gateway 02
ssid=mywifi                                       # WiFI SSID
apn=DMM                                           # apn for 3G name
pwd=********                                      # pwd for Wifi
gwnn=                                             # Gateway nn
dev=0           #flip between prod and dev servers
```

5.3 SENSORS.TXT

```
s1e=1           #Sensor 1 enabled
s1f=334         #Sensor 1 uSv/h conversion factor
s1i=Cs137       #Sensor 1 Isotope
s2e=1           #Sensor 2 enabled
s2f=120         #Sensor 2 uSv/h conversion factor
s2i=Cs137       #Sensor 2 Isotope
aux=0           #Aux input (not in use)
```

5.4 YYYYMMDD.TXT

```
$PNTDD,95,2015-04-08T03:22:00Z,,,0,A,3428.9558,N,1369.8009,E,1,A,,*5C
$PNTXS, 1001,23,4.89,*4D (device id, temperature, voltage, etc)
```

5.5 BUFFER.TXT

```
$PNTDD,95,2015-04-08T03:22:00Z,,,0,A,3428.9558,N,1369.8009,E,1,A,,*5C
$PNTXS, 1001,23,4.89,*4D
```

5.6 CONFIG.TXT

```
9600,26,3,2
```

6. FLOW DIAGRAM