

BIRDS-2 Communication Plan and CW Beacon Data Format

Last Revision: February 27, 2017

Tentative Daily Operational Plan of BIRDS-2 Cubesat Constellation

Satellite: BIRD-PHL		
Approximate Period (Time UTC)		Mission/Activity
Start (Time UTC)	End (Time UTC)	
00:00	01:00	APRS-Digipeater
01:00	02:00	Store-and-Forward
03:00	03:10	Image Acquisition
03:30	04:00	Orbit Measurements
04:30	04:40	Mission Data Download
18:00	19:00	APRS-Digipeater
19:00	20:00	Store-and-Forward
20:00	20:10	Satellite Housekeeping/Telemetry

Satellite: BIRD-MYS		
Approximate Period (Time UTC)		Mission/Activity
Start (Time UTC)	End (Time UTC)	
00:00	00:10	Image Acquisition
00:30	01:00	Orbit Measurements
02:00	03:00	APRS-Digipeater
03:00	04:00	Store-and-Forward
06:10	06:10	Mission Data Download
20:00	21:00	APRS-Digipeater
21:00	22:00	Store-and-Forward
23:00	23:10	Satellite Housekeeping/Telemetry

Satellite: BIRD-BTN		
Approximate Period (Time UTC)		Mission/Activity
Start (Time UTC)	End (Time UTC)	
00:00	00:10	Image Acquisition
00:30	01:00	Orbit Measurements
01:30	01:40	Mission Data Download
04:00	05:00	APRS-Digipeater
05:00	06:00	Store-and-Forward
21:30	21:40	Satellite Housekeeping/Telemetry
22:00	23:00	APRS-Digipeater
23:00	00:00	Store-and-Forward

Note: CW Beacon (Morse Code) is planned to be transmitted every 90 minutes for 3 minutes. During CW beacon, normal operational schedule is interrupted. Proper timing of CW beacon will be implemented to minimize interference.

Uplink Command

- BIRDS-2 satellites will use the same uplink frequencies. The uplink command contains a header that specifies the satellite targeted. Only the satellites specified in the header responds to the command. Other satellites not specified ignore the command.
- There is a command (CW Reference Command) to halt all RF transmission for approximately 10 minutes. The three satellites share the same downlink frequency in time-division-multiple-access manner. This command gives the time reference for each satellite to start CW transmission.

Telemetry/Mission Downlink

- There may be a risk of RF signal interference among signals from the satellites, especially when they are close proximity to each other. To mitigate this, timing of uplink and downlink operations is carefully scheduled and implemented. No two satellites simultaneously uplink and downlink at all times.

CW Transmission

- There may be a risk of CW signal interfere when the satellites fly in proximity to each other. To mitigate, the following solutions will be adopted:
 - Each satellite repeats cycles of CW transmission time and CW off time. Satellites CW off time duration shall be at least three times longer than CW transmitting time.
 - All satellites shall have different CW starting time. The reference time is the time when the satellite is deployed. The reference time can be updated by sending “CW Reference Command” from a ground station.

CW Beacon Format

Country	Callsign	Housekeeping Data
Bhutan	To be announced	123456789ABCDEFG
Malaysia	To be announced	
Philippines	To be announced	

Data Number (1 cell one 4 bit)	Data
1	Battery voltage (mV)
2	Battery current (mA)
3	Battery temperature
4	OBC Temperature
5	BackPlane Temperature
6	Transmitter temperature
7	Share memory -----> Nomal:1 Trouble:0
8	Reservation command --> Reserve:1 Nothing:0
9	Operation mode --> Mission:1 Nomial:0
A	Kill Switch_Main -----> Nomal:1 Kill:0
B	Kill Switch_COM -----> Nomal:1 Kill:0
C	Reserved data 0x00
D	Solar cell X -----> Sunshinel:1 Shadow:0
E	Solar cell -X -----> Sunshinel:1 Shadow:0
F	Solar cell +Y -----> Sunshinel:1 Shadow:0
G	Solar cell -Y -----> Sunshinel:1 Shadow:0
	Solar cell +Z -----> Sunshinel:1 Shadow:0
	Antenna Deploy Status --> Success: 1 Unsuccess: 0
	Time (hour from restart)0~16 hour

Battery voltage	$((2.5 * \text{return_data} * 16 / 4095) * 2000);$
Battery current	$((2.5 * \text{return_data} * 16 / 4095) * 1000 - 1250) * 2$
Battery temperature	if(return_data<=128) { return_data*16/4 plus degree celsius }
OBC Temperature	else { (4096-(return_data*16))/4 minus degree
BackPlane Temperature	
1200TX temperature	