BIRDS-3 Uplink and Downlink Communication plan

1st March 2018

Uplink command

- The BIRDS-3 satellites uses 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.

Downlink Telemetry

There may be a risk of FM packet signal interfere with CW signals from other satellites when the satellites fly in proximity to each other. To mitigate, the following steps are taken,

i. Send General Command to stop RF temporally of all the satellites
ii. All the satellites nearby halts RF transmission for approximately 10 minutes and go to receiving mode.
iii. Send an command only to a specific satellite to downlink FM packet

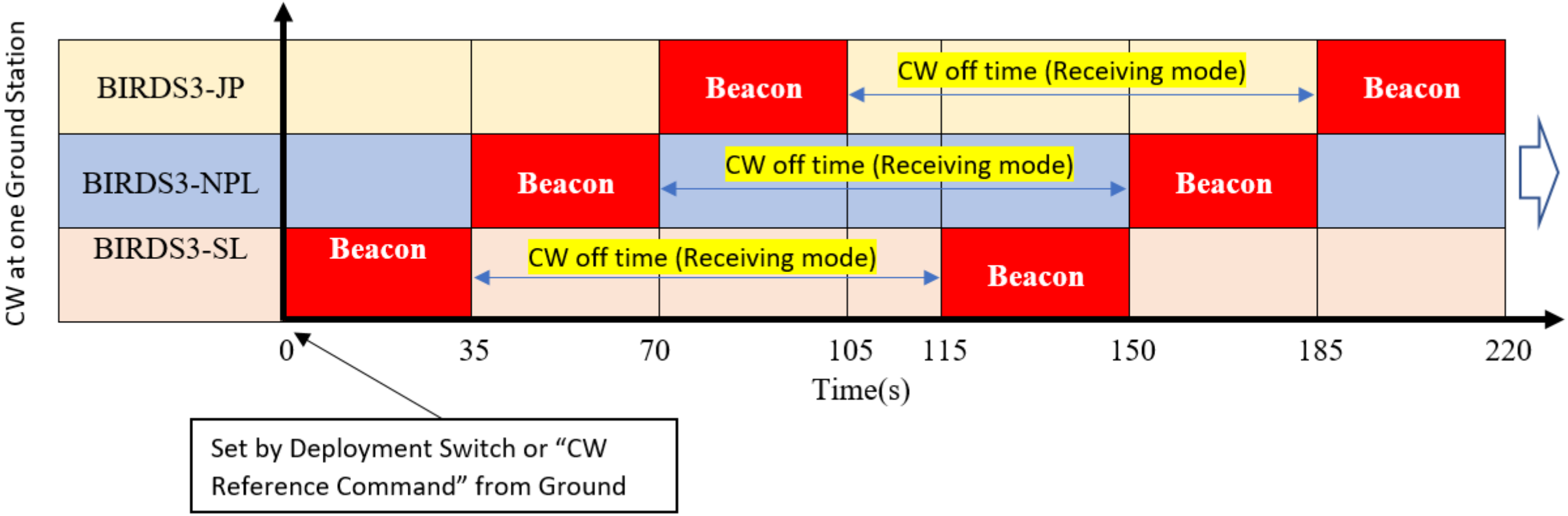
CW transmission

There may be a risk of CW signal interfere when the satellites fly in proximity to each other. To mitigate, the following solutions are adopted

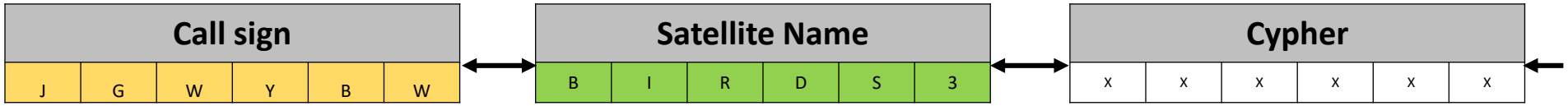
- Each satellite repeats cycles of CW transmission time and CW off time. Satellites CW off time duration shall be slightly more than two times longer than CW transmitting time. During the CW off time satellite goes to listening mode.

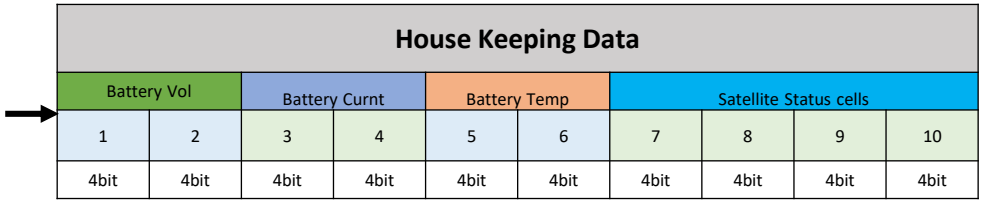
- All satellites shall have different CW starting time. The reference time is the time when the satellite is deployed. The reference time can be updated by sending “CW Reference Command” from a ground station.

CW transmission example of three BIRDS-3 satellites



CW Beacon Format





Cell Number	Data				
1	Battery Voltage (mV)				8bit
2					
3	Battery Current (mA)				8bit
4					
5	Battery Temperature				8bit
6					
7	Battery Heater -------> Disabled:1 Enabled:0				1bit
	Reservation command ----> Reserve:1 Nothing:0				1bit
	Operation Modes	0	1	1	2bit
		1	0	1	
8	Kill Switch_Main -----> Nomal:1 Kill:0				1bit
	Kill Switch_COM -----> Nomal:1 Kill:0				1bit
	Antenna deploy status------> Success:1 Unsuccess:0				1bit
	Solar cell +X----------> Sunshine:1 Shadow:0				1bit
9	Solar cell -X----------> Sunshine:1 Shadow:0				1bit
	Solar cell +Z----------> Sunshine:1 Shadow:0				1bit
	Solar cell -Z----------> Sunshine:1 Shadow:0				1bit
	Solar cell -Y----------> Sunshine:1 Shadow:0				1bit
10	Time after last reset (number of hours)				4bit

01 = Safe Mode | 10 = Low power Mode
11 = Normal Mode