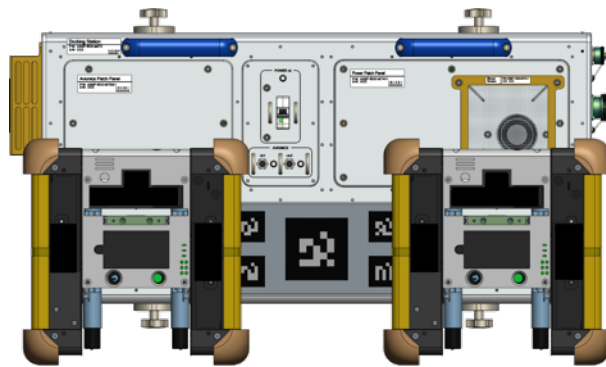# Astrobee System Overview

SPHERES/Astrobee Working Group

November 30, 2017

Astrobee Elements

Astrobee
- Free Flyer
- Dock
- Ground Data System
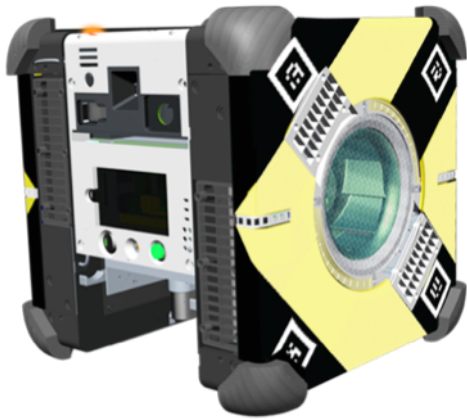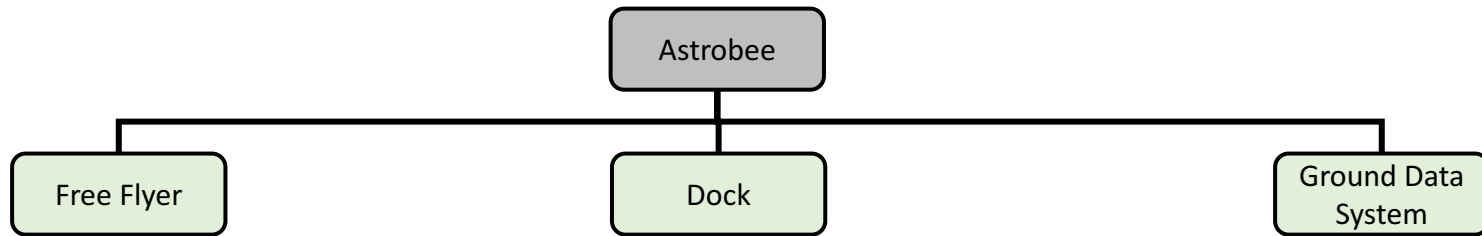
System Data Flow Diagram

ISS

Queen
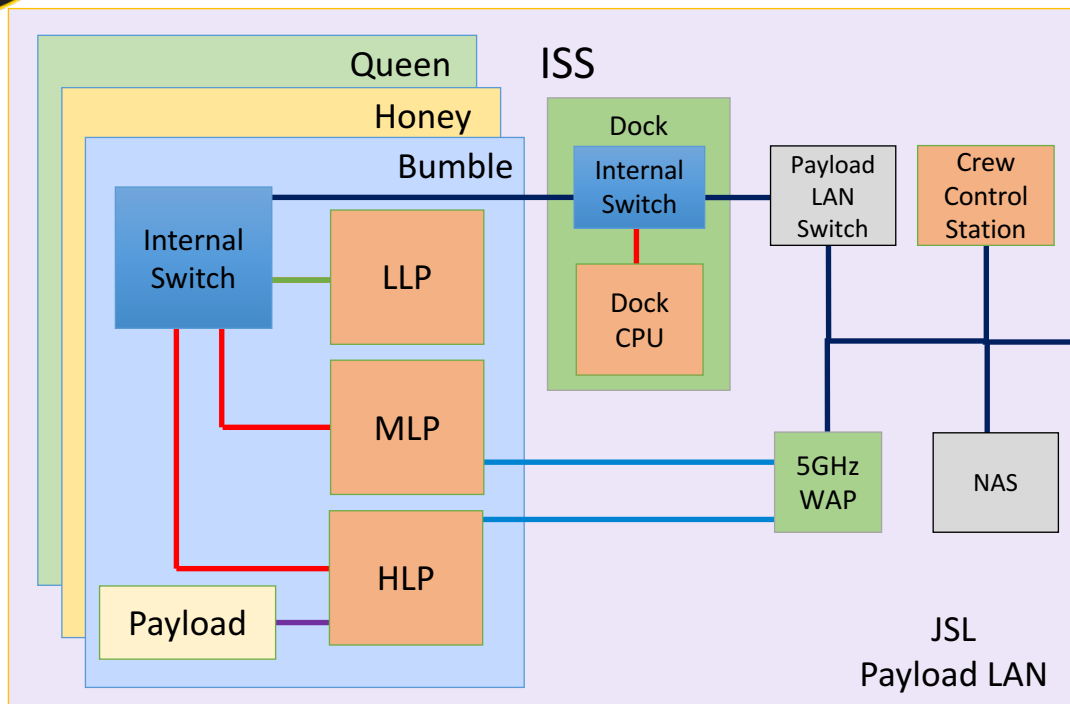Honey
Bumble

Internal Switch

LLP

MLP

HLP

Payload

Dock

Internal Switch

Dock CPU

Payload LAN Switch

Crew Control Station

5GHz WAP

NAS

Ku-Band

JSL Payload LAN

White Sands

Link Legend

Ethernet/LAN

Ethernet: Internal IP

Ethernet: Internal and Payload LAN

WiFi: Payload LAN

USB

Other/LAN

GS Inst

Operator Control

ARC MMOC

Storage

Operator/ Engineer Control

MSFC

Operator Control (POIC)

Ground Relay (HOSC)

JSC MCC

Operator Control

Astrobee

Speaker/Microphone
NavCam
Nozzle
Battery
Terminate Button
SciCam
SpeedCam
Laser Pointer
Arm
HazCam
Touch Screen
Power Switch
PerchCam
DockCam
Forward Flashlight
Aft Flashlight
Signal Lights
Wake Button
Corner Bumpers
Impeller
Status LEDs
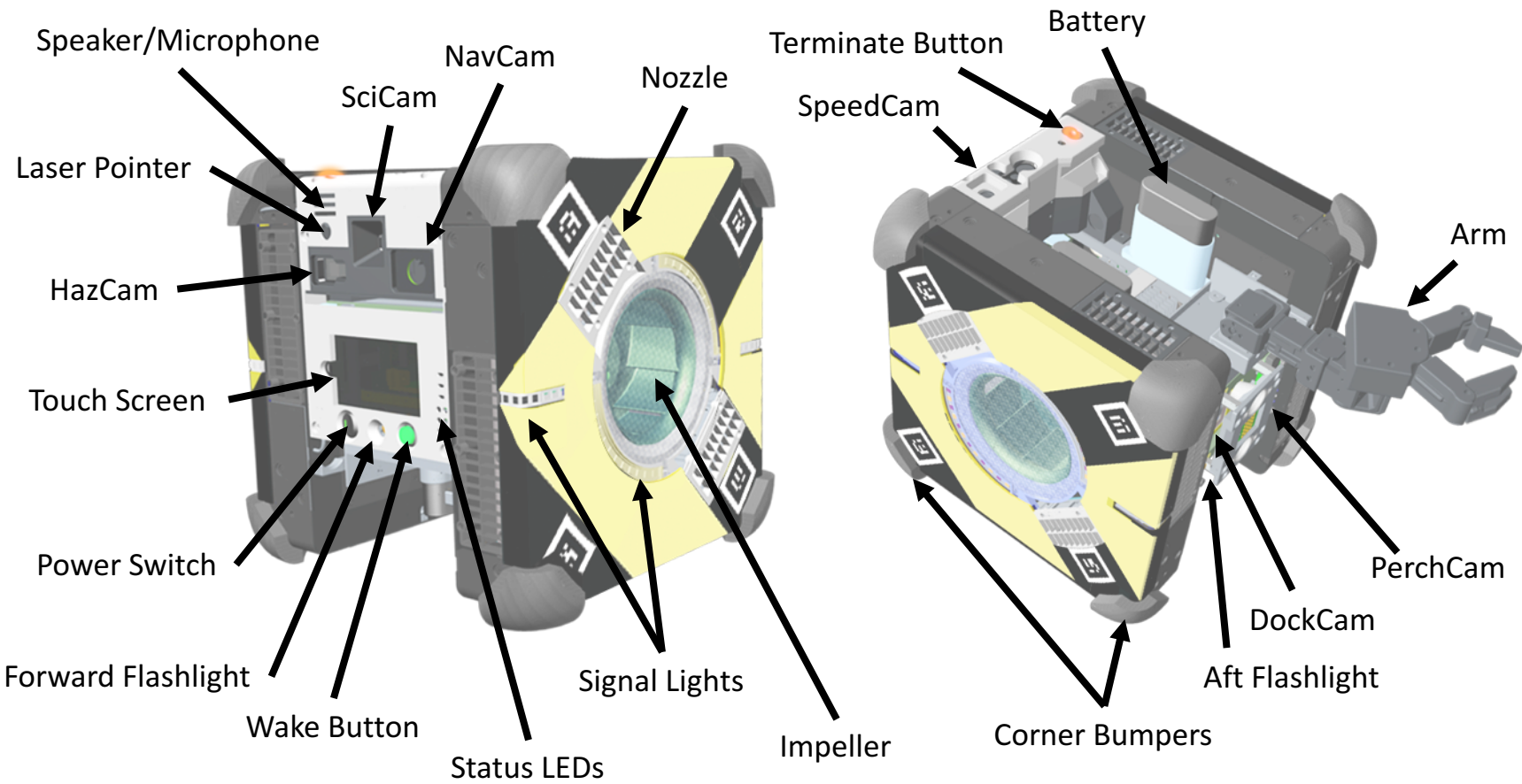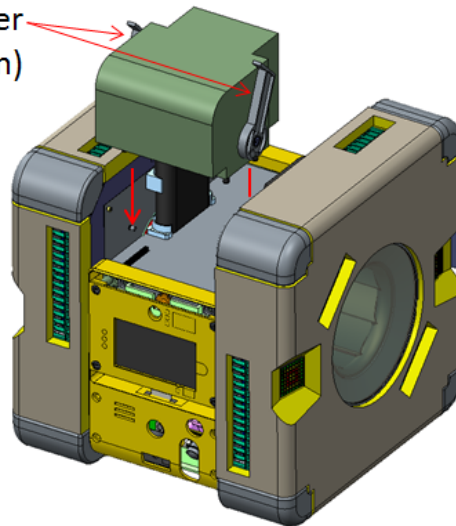
Payload Attachment Options

Quick "No Tool" Payload Attachment
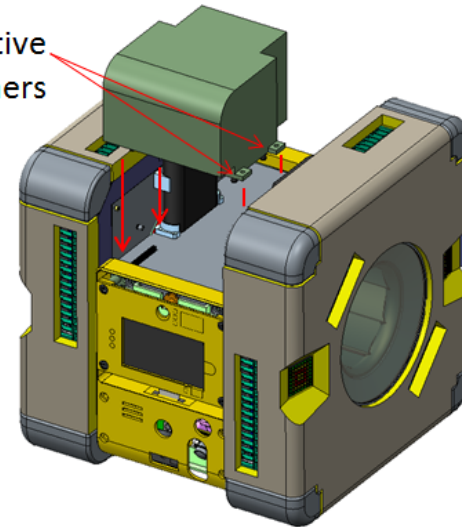
2X Lever
(open position)

Lever engages and
disengages
payload connector
and provides
mechanical
attachment

Lever in "Locked"
position

4X Fastener Payload Attachment
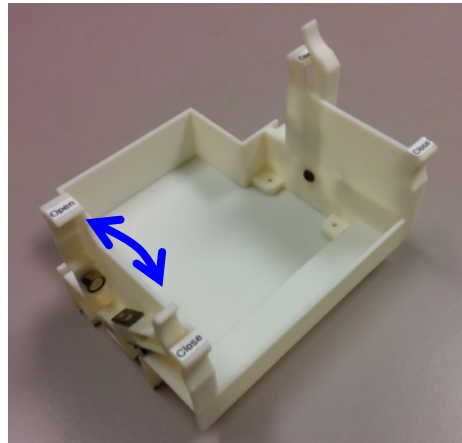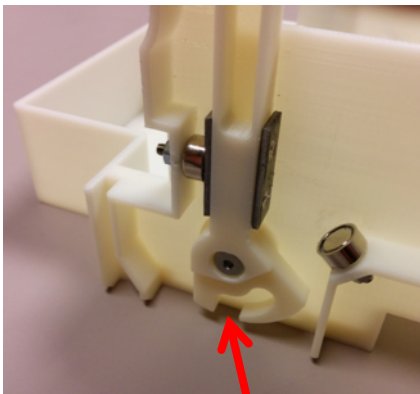
4X Captive
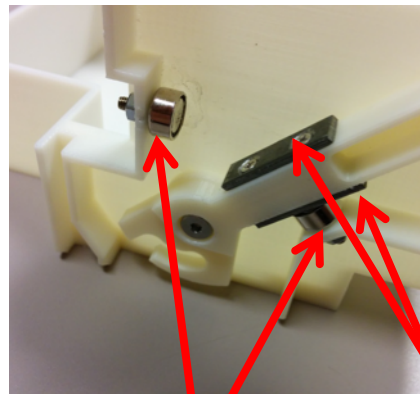Fasteners
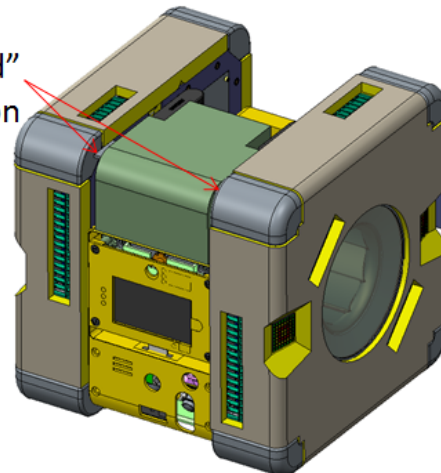
Quick-Release Mechanism Prototype
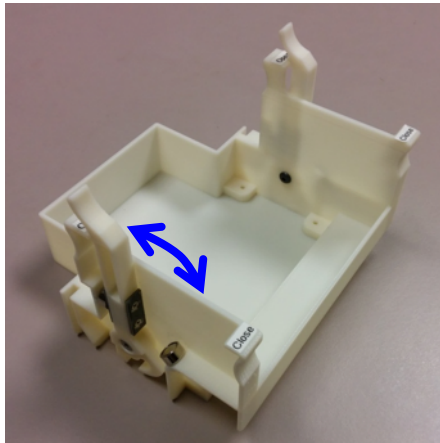
Open Position

Closed Position

Clevis Slot

Magnets

Steel Striker Plates

- Mechanism shown will be part of the payload reference design (payload developers are encouraged to use)

- This mechanism is part of Astrobee's baseline perching arm, which can be swapped with a payload

- Clevis slot engages with a simple fixed clevis in the payload bay, pulling the payload down into a tight fit

- Levers can be actuated individually with one-handed pinch motion (crew human factors)

- Lever actuation will also mate/demate avionics connector (not shown)

- To enable rapid payload development, mechanism is designed to be 3D printed in ISS-compatible Ultem material, supplemented with small COTS hardware items (magnets, plates, screws, etc.)
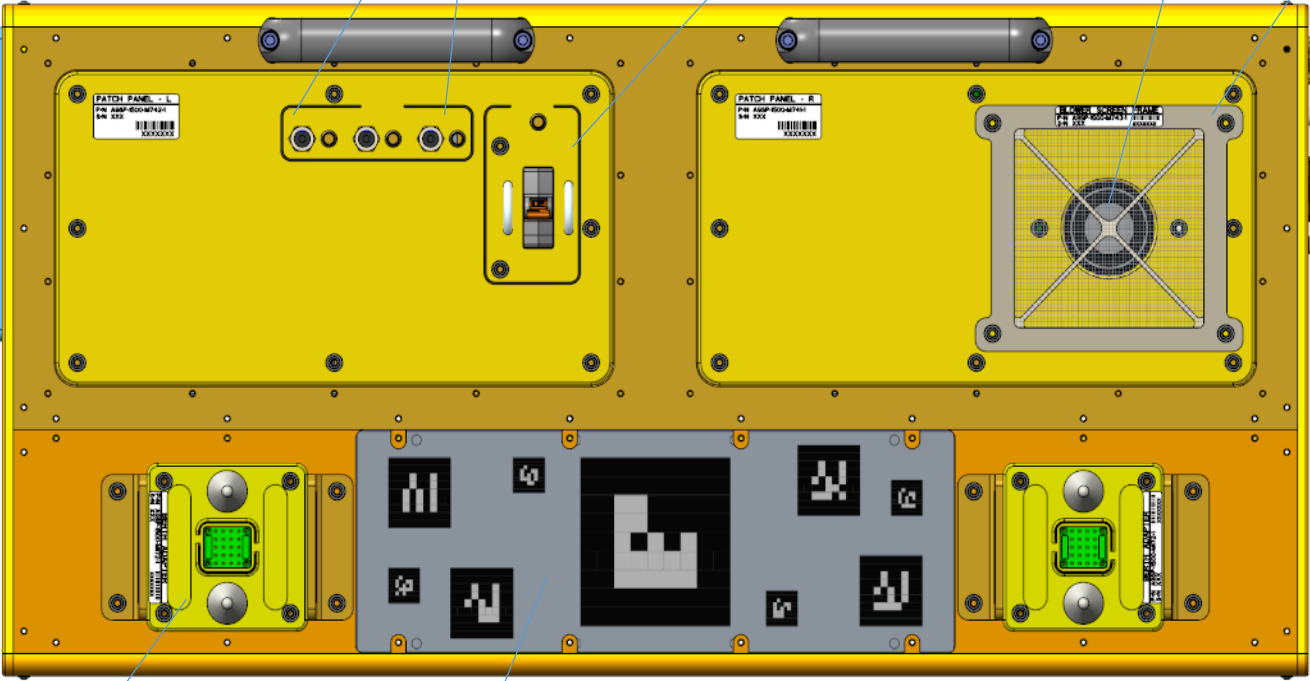
Dock

Cooling Fan

Subsystem Breakers

Main Power Breaker

Cooling Fan Screen

Air Vent Deflector

RJ-45 Connector

Power Connector

Free Flyer Berth

AR Target

Plan Editor Tab (Operator/Engineering)

Run Plan Tab (All)

List view of loaded plan

Model of loaded plan

Select valid plan and upload to Astrobee

Teleoperation Tab (All)

Guest Science Tab (Crew)

Advanced Guest Science Tab

(Operator/Engineering)

Advanced Tab (Engineering)

Astrobee Engineering Workbench

File   Edit   View   Modeling   Help

Plan Editor | Run Plan | Teleoperation | Guest Science | Advanced Guest Science | **Advanced** | Advanced 2 | Modeling | Debugging

FreeFlyerA   Comm ●   Control nobody   Batt 11

Docking Station ◐   GPS 18Jan17 18:23:54

Detailed Health and Status

Disabled Subsystems	Subsystem A, Subsystem C
Control	nobody
Operating State	Ready
Raw Mobility State	Stopping
Sub Mobility State	0
Operating Limits	Default_Safeguard
Plan	
Plan Status	Idle
Temperature	-
Arm Mobility	-
Arm Gripper	-

Detailed Health and Status

FreeFlyerA Operating Limits

Select Operating Limits Configuration ...

Configure Data

Name	V
Profile Name	Def
Flight Mode	Def
Target Linear Velocity	1.0
Target Linear Accel	1.0
Target Angular Velocity	1.0 rad/s
Target Angular Accel	1.0 rad/s/s
Collision Distance	1.0 m
Check Obstacles	true
Check Keepouts	true
Enable Auto Return	true

View and change Operating Limits

FreeFlyerA Data to GDS 2

Telemetry	Current Freq (Hz)	Change to (Hz)	
position	5	5	Set
ekfState	7	5	Set
commStatus	8	5	Set
diskState	17	5	Set

Camera	Streaming	Resolution		FPS		Bandwidth			
science	No	640_480	640_480	0.0	0.0	0.0	0.0	0.0	Set
navigation					0.0		0.0		Set
hazard	No	640_480	640_480	0.0	0.0	0.0	0.0	0.0	Set

Configure telemetry sent to Control Station

Fault ID	Description	Subsystem	Node
▲ Triggered			
120	SciCam is inoperable	Subsystem A	Node 2
127	Fuse is broken	Subsystem C	Node 3
▲ Not Triggered			
100	Processor overheated	Subsystem A	Node 1
201	Arm Overcurrent	Subsystem B	Node 3

Triggered and Not Triggered Faults

FreeFlyerA Power State

Battery Total 1
Voltage 2
Current 2

Battery	Present		
Batt 1	No		
Batt 2	No	-	
Batt 3	Yes	32	16
Batt 4	No	-	-
Batt 5	Yes	91	30
Batt 6	Yes	73	10
Batt 7	No	-	-

Detailed battery status

FreeFlyerA Component States

Component	Present	Powered	Temp (C)	Current (A)
HLP	Yes	No	33	-1.458
MLP	Yes	Yes	112	2.107
LLP	Yes	No		
Fan1	Yes			
Fan2	No			
Cam1	No			
Cam2	Yes			
Cam3	Yes			

Detailed component status

FreeFlyerA Data to Disk

Download Data | Stop Data Download | Clear Data

Disk	Data Size (GB)	Disk Size (GB)
Disk A	0.000002	0.000002
Disk B	0.000003	0.000003
Disk C	0.000003	
Disk D	0.000003	
Disk E	0.000005	
Disk F	0.000006	
Disk G	0.000005	

Disk usage

Topic	Downlink	Freq (Hz)
RosTopic0	Immediate	5.0
RosTopic1	Immediate	5.0
RosTopic2	Immediate	5.0
RosTopic3	Delayed	10.0
RosTopic4	Delayed	
RosTopic5	Delayed	
RosTopic6	Delayed	

Configure Data

View and configure data saved to disk

Message
Select a fault to view message.

00:00:00 Message goes here

Astrobee Status

- Drawings complete

- Available to Guest Scientists:
  - Beta release of Flight Software/Simulator
  - Mechanical Payload ICD drawings
  - Initial draft of the Guest Science Guide

- Finalizing procurement

- Integration begins December 19th

- On-dock (hardware delivery) date April 4, 2018