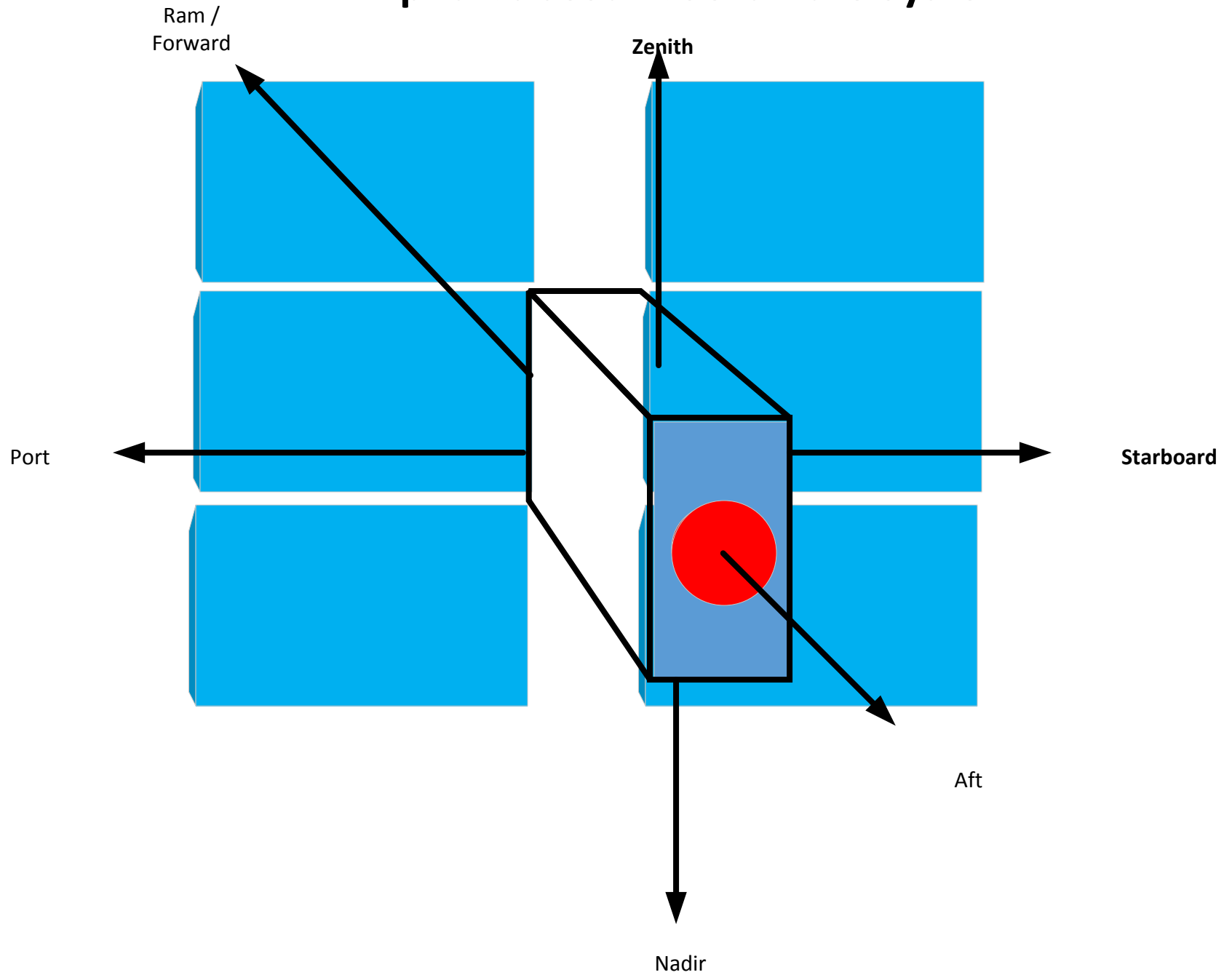


Alpha CubeSat Coordinate System



Alpha CubeSat Electrical Power System (EPS)

Ground Support Equipment
Trickle Charger
Power Interface

Battery Subsystem

Use of an Integrated Solar Array and Reflectarray Antenna (ISARA) like design is baselined for all Solar Panels

Battery
Power Interface

Solar Panel Port
Power Interface

Solar Panel Starboard
Power Interface

Passive Power Source Inhibit Mechanism

Solar Reflectarray Subsystem

Source Manager Control Interface

Power Management And Distribution (PMAD) Subsystem

DMS Interface
Telemetry, Command & Control

Load Manager Control Interface

Starboard Solar Reflectarray

COMM
Reflectarray
Antenna Interface

6U Solar Panel
Starboard Zenith
(SPSZ)

Panel Hinge SZ

Starboard Array Mount

Deployment Mechanism

Starboard Single Axis
Articulation Servo

6U Solar Panel
Starboard Middle
(SPSM)

Panel Hinge SN

6U Solar Panel
Starboard Nadir
(SPSN)

Sun Sensor S

Port Solar Reflectarray

6U Solar Panel
Port Zenith
(SPPZ)

COMM
Reflectarray
Antenna Interface

Panel Hinge PZ

6U Solar Panel
Port Middle
(SPPM)

Port Array Mount

Deployment Mechanism

Port Single Axis
Articulation Servo

Panel Hinge PN

6U Solar Panel
Port Nadir
(SPPN)

Sun Sensor P

EPS LOAD INTERFACES

PROP
Power Interface

GN&C
Power Interface

COMM
Power Interface

DMS
Power Interface

Secondary Payload
Power Interface

TIB
Power Interface

TCS
Power Interface

S&Mech
Power Interface

PS
Power Interface

KEY:

Baseline Subsystem

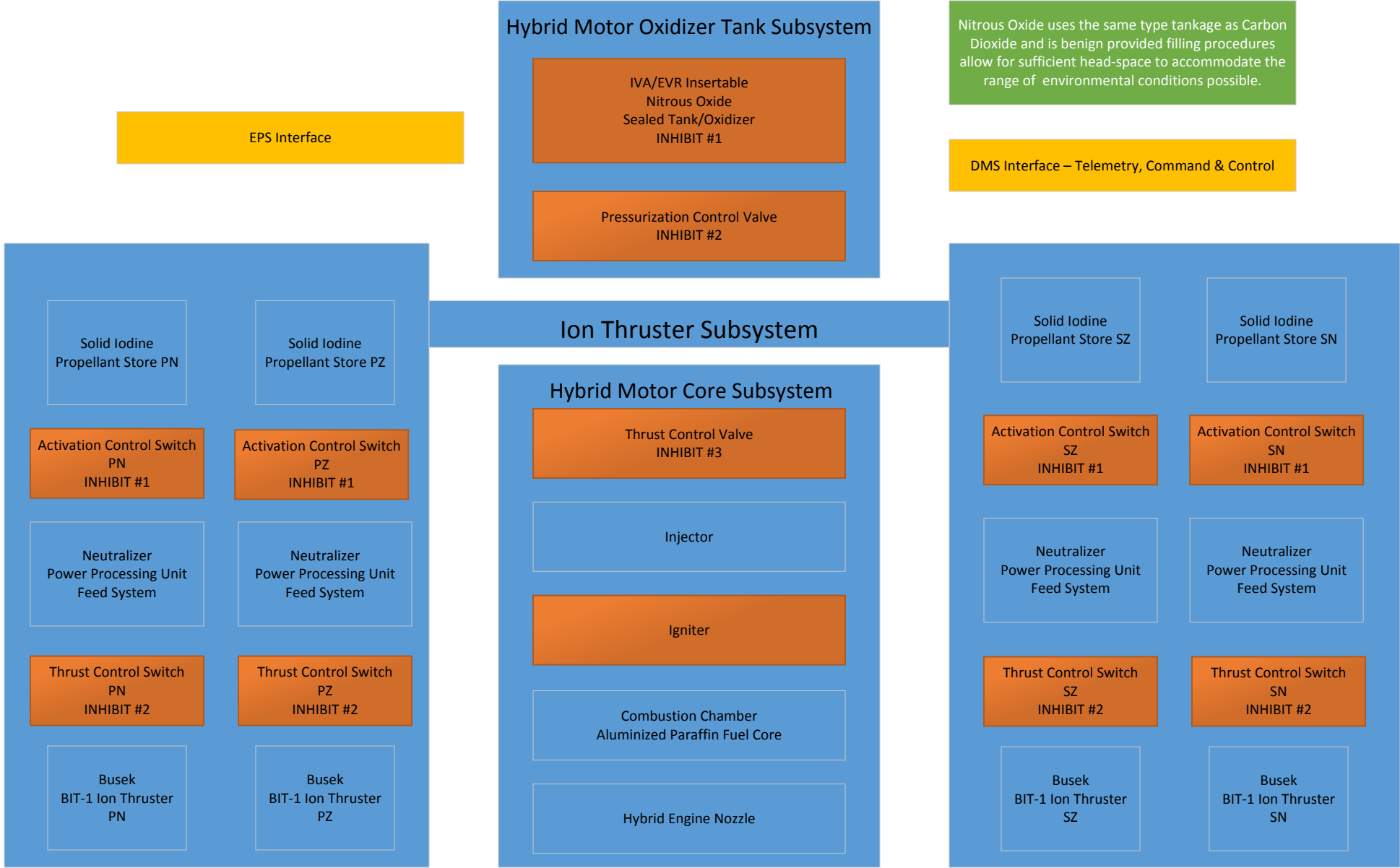
Primary Interface

Safety Critical

Highlight

Optional

Alpha CubeSat Propulsion System (PROP)



KEY:

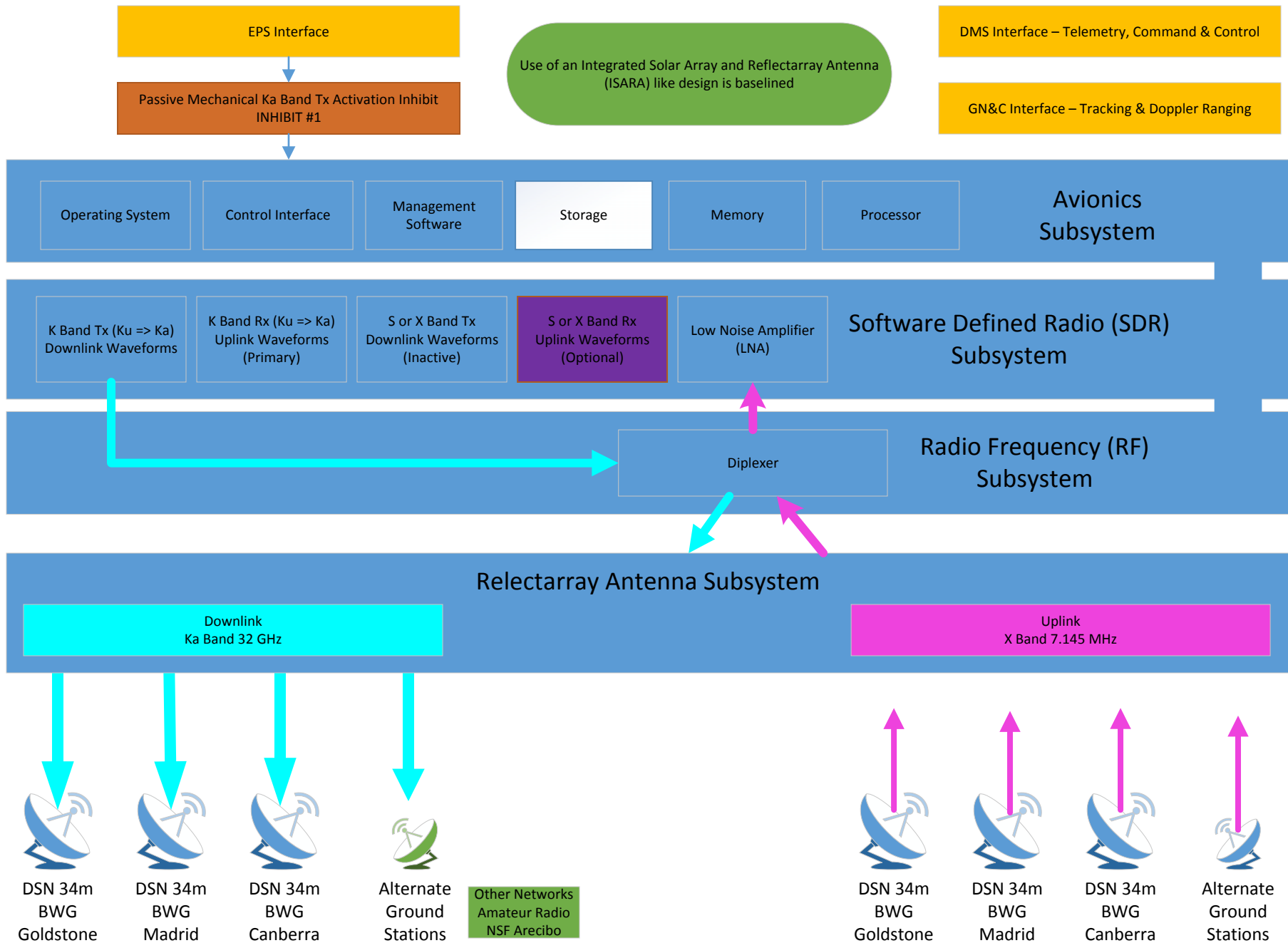
Baseline Subsystem

Primary Interface

Safety Critical

Highlight

Alpha CubeSat Communications System (COMM)



KEY:

Baseline Subsystem

Primary Interface

Safety Critical

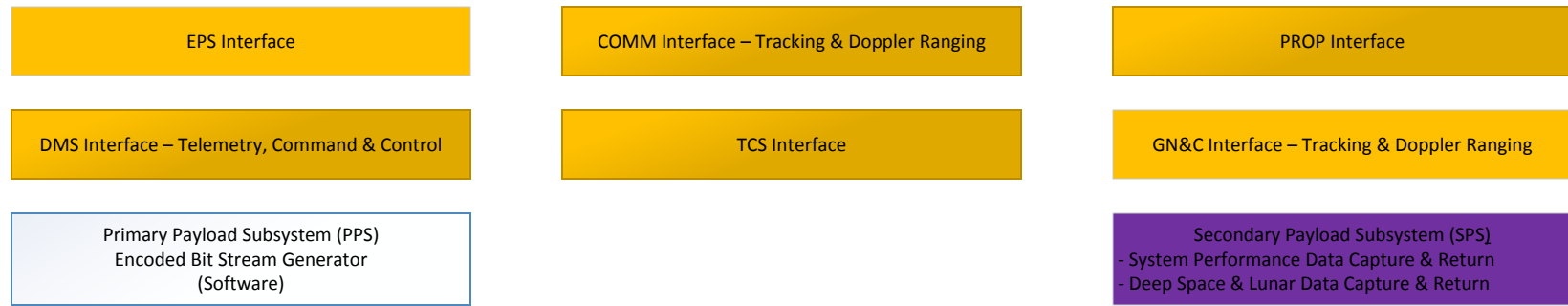
Downlink

Uplink

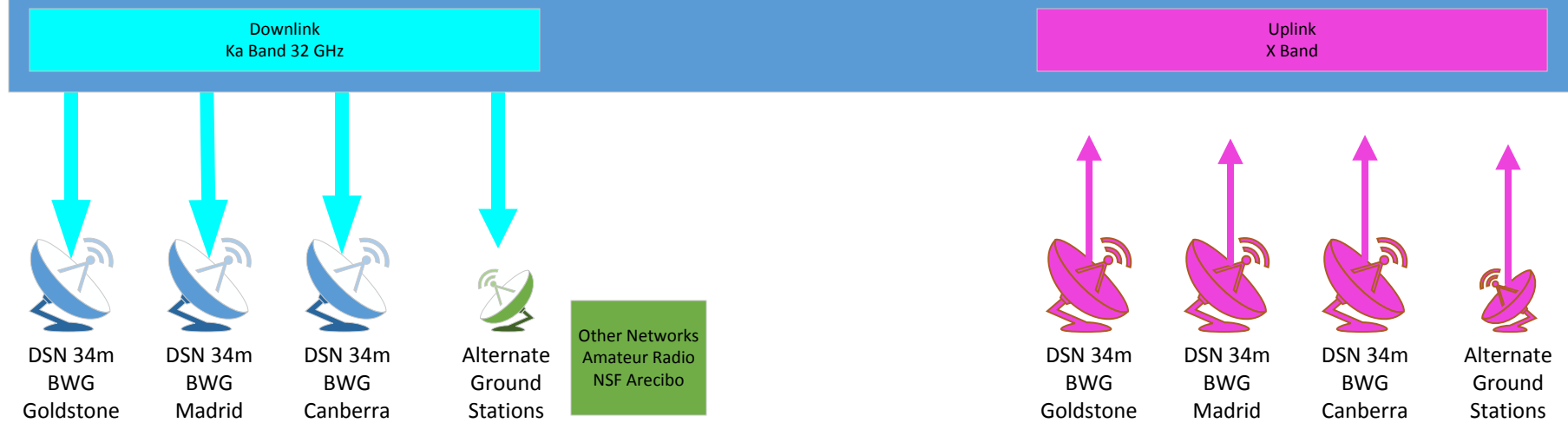
Highlight

Optional

Alpha CubeSat Ground Systems



Alpha CubeSat Relectarray Antenna Subsystem



Signal Processing
Center SPC-10

Signal Processing
Center SPC-60

Signal Processing
Center SPC-40

Under Review

Signal Processing
Center SPC-10

Signal Processing
Center SPC-60

Signal Processing
Center SPC-40

Under Review

- Spacecraft Control Center (Virtual Web Based Control Center)
 - Spacecraft Near Real Time State Model Generator & Status Display
 - Capture & store required navigation bits
 - Spacecraft Operators
 - Internet VLAN (to authorized locations with authenticated operators)
 - Automated Command Sequence Generation and Verification Tool

- Payload Operations Center (Virtual Web Based Operations Center)
 - Payload Near Real Time State Model Generator & Status Display
 - Capture and store Cube Quest Challenge encoded bit stream
 - Payload Operators
 - Internet VLAN (to authorized locations with authenticated operators)
 - Automated Command Sequence Generation and Verification Tool

KEY:

Baseline Subsystem

Primary Interface

Safety Critical

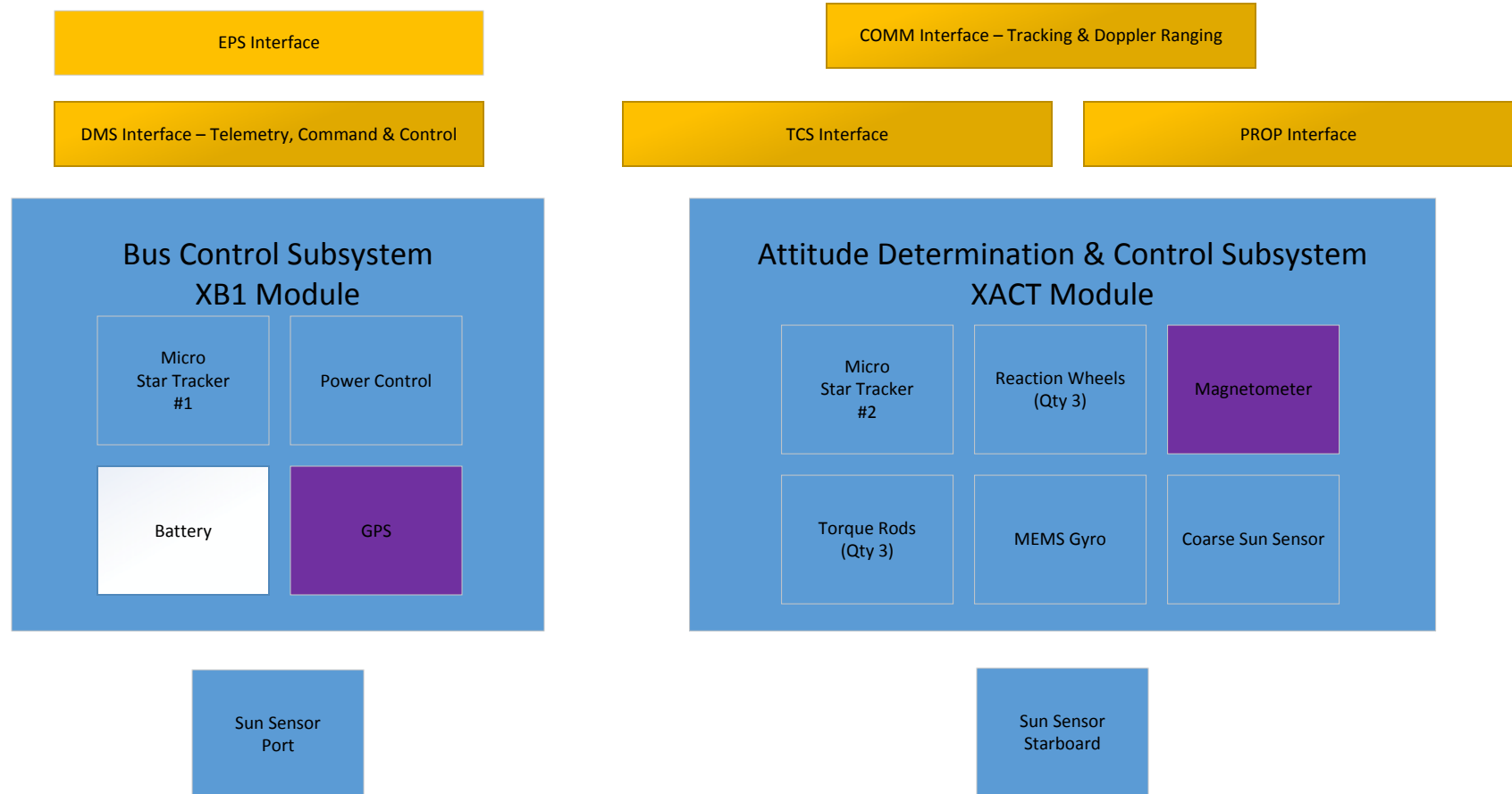
Downlink

Uplink

Highlight

Optional

Alpha CubeSat Guidance, Navigation, & Control System (GN&C)



KEY:

Baseline Subsystem

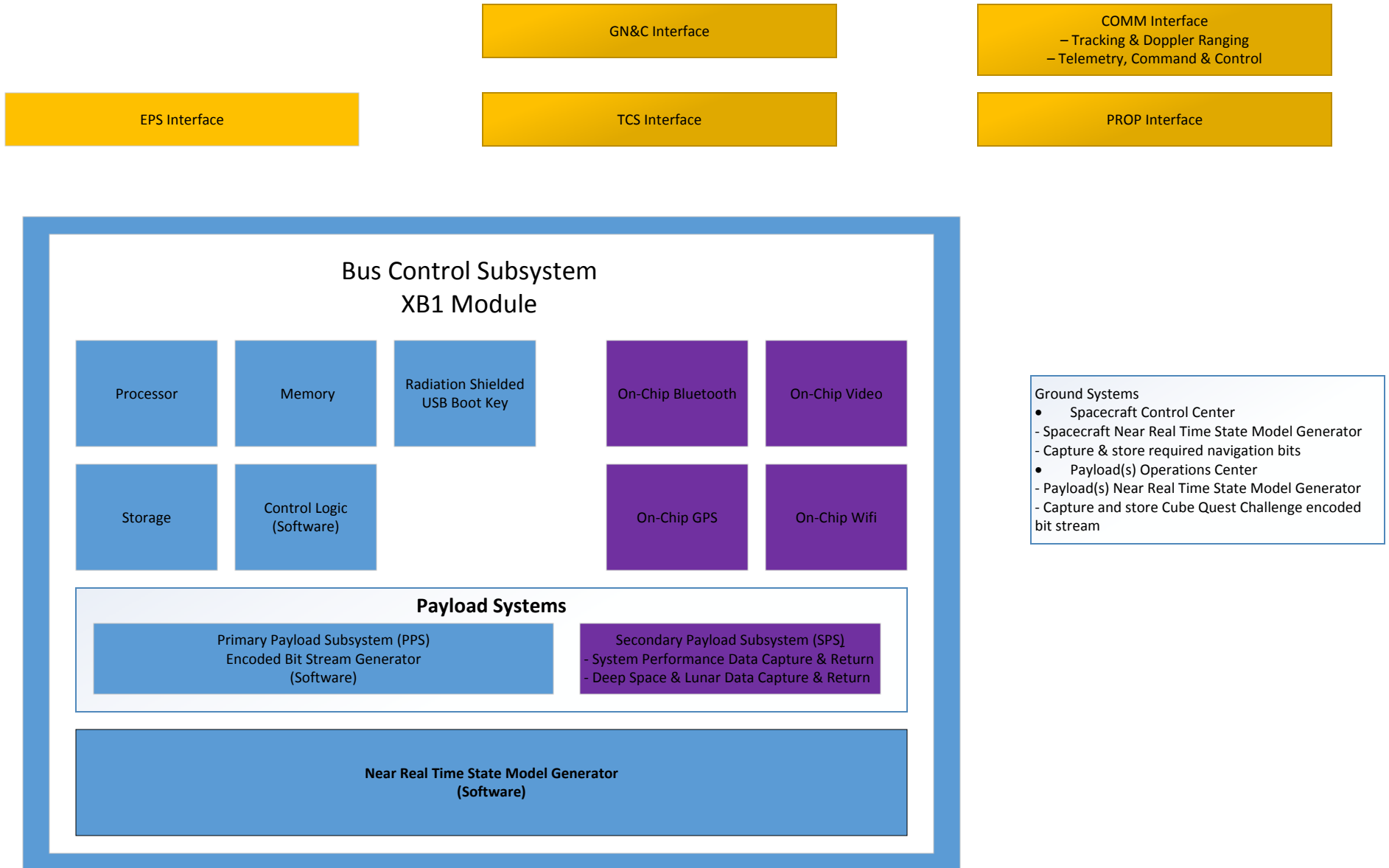
Primary Interface

Safety Critical

Highlight

Optional

Alpha CubeSat Data Management System



KEY:

Baseline Subsystem

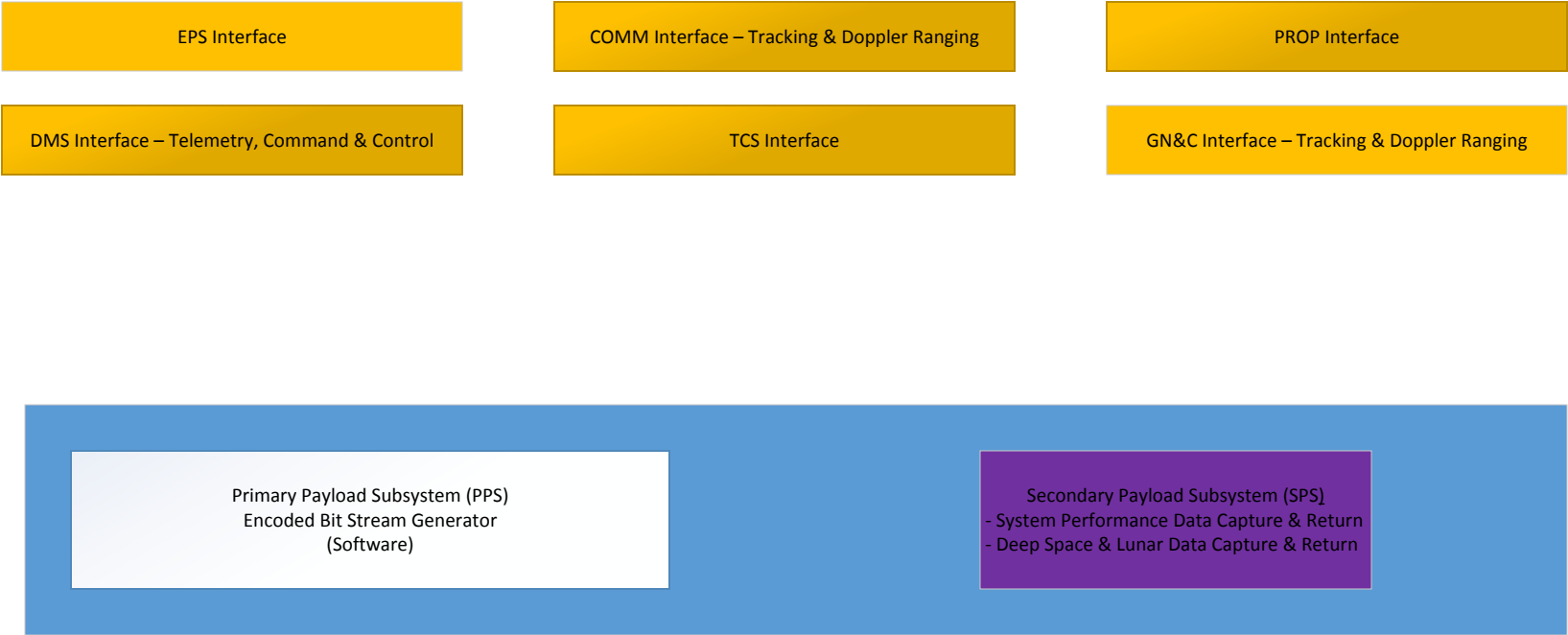
Primary Interface

Safety Critical

Highlight

Optional

Alpha CubeSat Payload System



KEY:

Baseline Subsystem

Primary Interface

Safety Critical

Downlink

Uplink

Highlight

Optional

Alpha CubeSat Launch Service Provider (LSP) Systems

DMS Interface – Telemetry, Command & Control

COMM Interface – Tracking & Doppler Ranging

GN&C Interface – Tracking & Doppler Ranging

EPS Interface

TIB Fairing (if applicable)

Upper Stage/Trajectory Insertion Bus (TIB)

ACS Transportation Packaging

Earth-to-LEO Launch Vehicle

KEY:

Baseline Subsystem

Primary Interface

Safety Critical

Downlink

Uplink

Highlight

Optional

Use of 3D printed aluminum or titanium tanks/structural spars with interior cellular microtruss structure to maximize available space for propellant storage and optimize the overall structural chassis being evaluated.

DMS Interface
– Telemetry, Command & Control

GN&C Interface

TCS Interface

Alpha CubeSat Structures & Mechanisms

EPS Interface

TIB Interface

TIB Spacecraft Deployment Mechanism Attach Point

Passive Power Source Inhibit Mechanism

1U x 3U Ram/
Forward Plate
Structure

Hybrid Motor
Oxidizer Tank
Subsystem

Mechanical Oxidizer
Tank Seal

2U x 3U Core
Structural Spars,
Rails & Plate

Scar for Aft Plate +
Hybrid Rocket +
Oxidizer Tank Jettison

1U x 3U Aft Plate
Structure

Ion Thruster Fuel Tank PZ

Ion Thruster Fuel Tank PN

Ion Thruster Fuel Tank SN

Ion Thruster Fuel Tank SZ

Use of an Integrated Solar Array and Reflectarray Antenna (ISARA) like design is baselined

COMM Interface
– Tracking & Doppler Ranging
– Telemetry, Command & Control

PROP Interface

Secondary Payload Subsystem (SPS)
- Memorial Spaceflight Canisters

Port Solar Reflectarray

6U Solar Panel
Port Zenith
(SPPZ)

COMM
Reflectarray
Antenna Interface

Panel Hinge PZ

6U Solar Panel
Port Middle
(SPPM)

Port Array Mount

Deployment Mechanism

Port Single Axis
Articulation Servo

Panel Hinge PN

6U Solar Panel
Port Nadir
(SPPN)

Sun Sensor P

Starboard Solar Reflectarray

COMM
Reflectarray
Antenna Interface

6U Solar Panel
Starboard Zenith
(SPSZ)

Panel Hinge SZ

Starboard Array Mount

Deployment Mechanism

Starboard Single Axis
Articulation Servo

6U Solar Panel
Starboard Middle
(SPSM)

Panel Hinge SN

6U Solar Panel
Port Nadir
(SPSN)

Sun Sensor S

KEY:

Baseline Subsystem

Primary Interface

Safety Critical

Highlight

Optional

Alpha CubeSat Thermal Control System (TCS)

DMS Interface
– Telemetry, Command & Control

GN&C Interface

EPS Interface

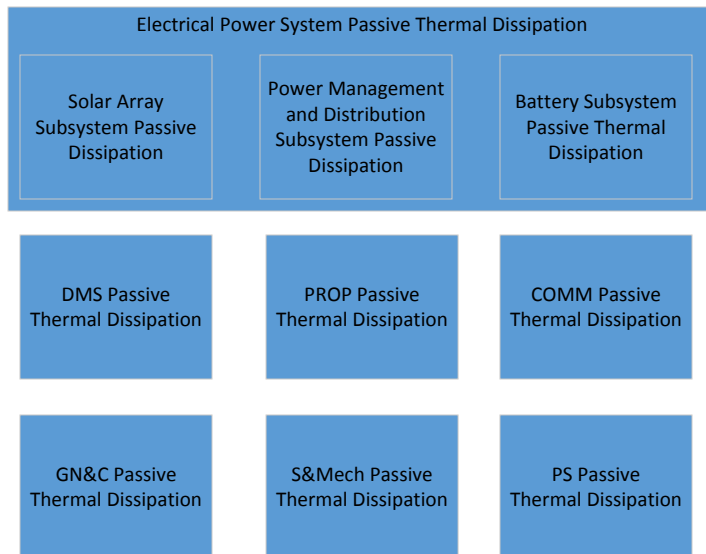
S&Mech Interface

COMM Interface

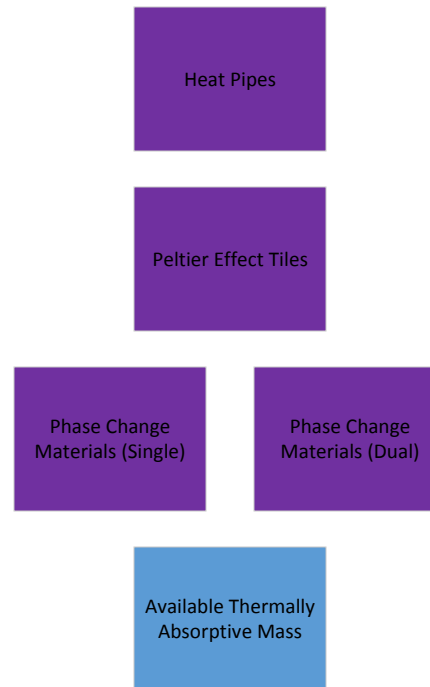
PROP Interface

PS Interface

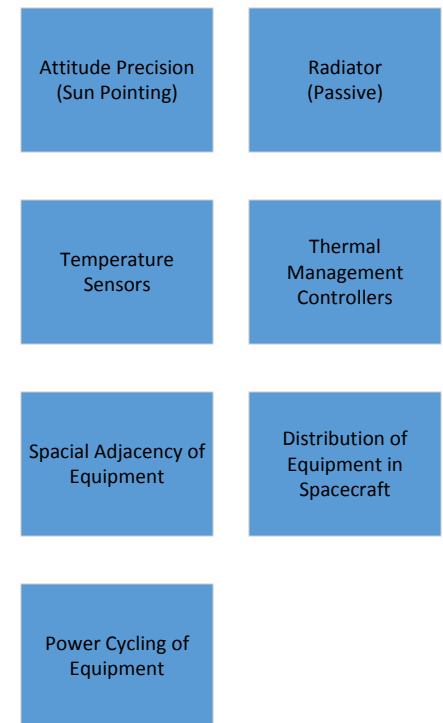
Heat Loads to Dissipate



Tools to Move Heat



Tools for Mitigating and/or Rejecting Heat



KEY:

Baseline
Subsystem

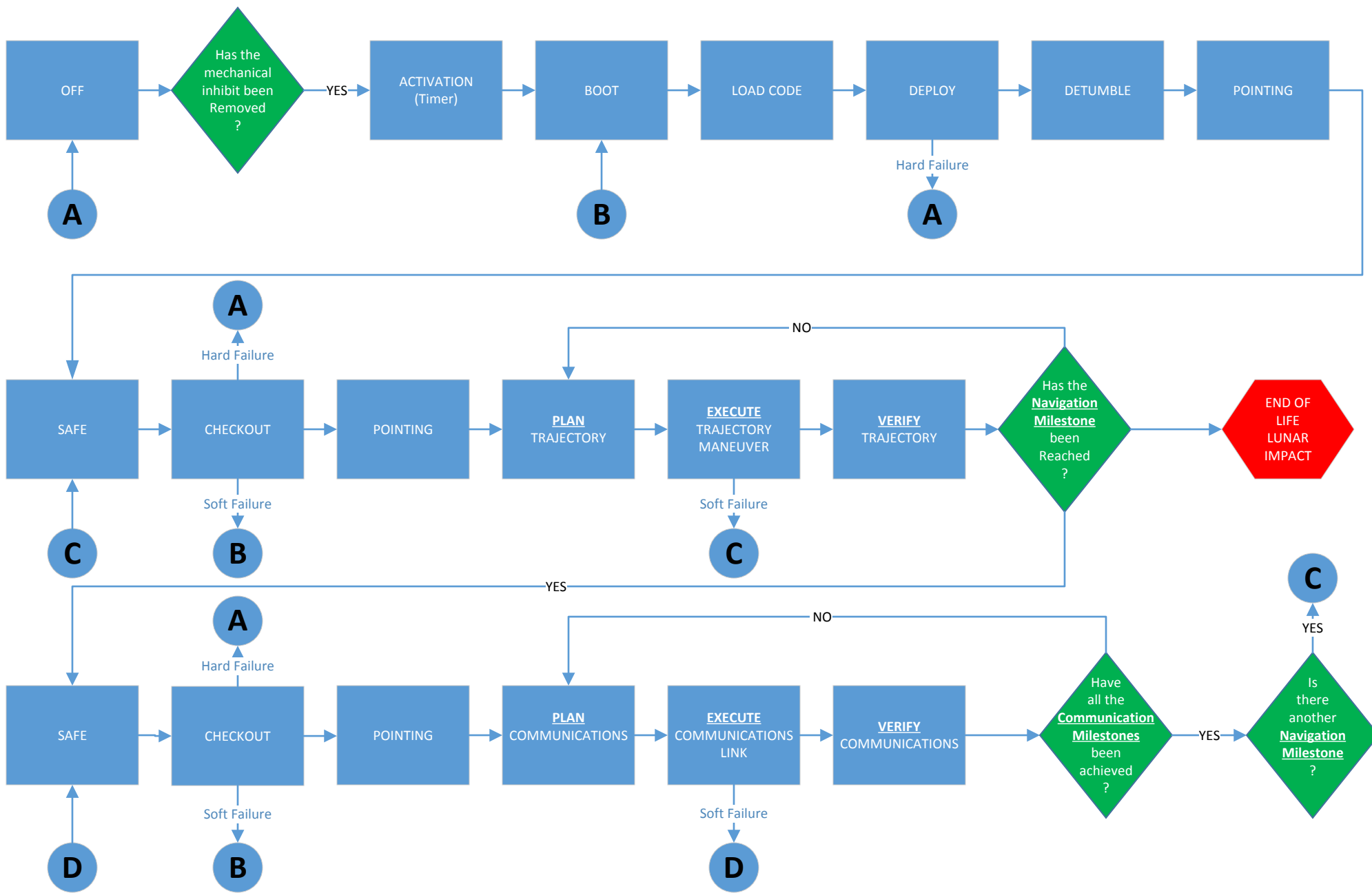
Primary
Interface

Safety Critical

Highlight

Optional

Alpha CubeSat Mode / State Transitions



Alpha CubeSat Mode / State Transitions

FROM	TO	OFF	ACTIVATION	BOOT	LOAD CODE	DEPLOY	DETUMBLE	POINTING	SAFE	CHECKOUT	PLAN TRAJECTORY	EXECUTE TRAJECTORY MANEUVER	VERIFY TRAJECTORY	PLAN COMMUNICATIONS	EXECUTE COMMUNICATIONS LINK	VERIFY COMMUNICATIONS
OFF		-	Timer	-	-	-	-	-	-	-	-	-	-	-	-	-
ACTIVATION		-	-	Scripted	-	-	-	-	-	-	-	-	-	-	-	-
BOOT		H-Reset	-	-	Scripted	-	-	-	-	-	-	-	-	-	-	-
LOAD CODE		-	-	-	-	Scripted	-	-	-	-	-	-	-	-	-	-
DEPLOY		H-Reset	-	-	-	-	Scripted	-	-	-	-	-	-	-	-	-
DETUMBLE		-	-	-	-	-	-	Scripted	-	-	-	-	-	-	-	-
POINTING		-	-	-	-	-	-	-	Scripted	-	Scripted	-	-	Scripted	-	-
SAFE		-	-	-	-	-	-	-	-	Scripted	-	-	-	-	-	-
CHECKOUT		H-Reset	-	S-Reset	-	-	-	Scripted	-	-	-	-	-	-	-	-
PLAN TRAJECTORY		-	-	-	-	-	-	-	-	-	-	Scripted	-	-	-	-
EXECUTE TRAJECTORY MANEUVER		-	-	-	-	-	-	-	Timer	-	-	-	Scripted	-	-	-
VERIFY TRAJECTORY		-	-	-	-	-	-	-	Scripted	-	Scripted	-	-	-	-	-
PLAN COMMUNICATIONS		-	-	-	-	-	-	-	-	-	-	-	-	-	Scripted	-
EXECUTE COMMUNICATIONS LINK		-	-	-	-	-	-	-	Timer	-	-	-	Scripted	-	-	-
VERIFY COMMUNICATIONS		-	-	-	-	-	-	-	Scripted	-	-	-	-	Scripted	-	-

H-Reset = Hard Reset turns the all systems off and restarts the activation timer (i.e., cold boots the spacecraft).

S-Reset = Soft Reset restarts all systems (i.e., warm boots the spacecraft).

Scripted = Command scripts are programmed sequences of commands which can be executed by scheduled time triggers and/or sensed event triggers.

Timer = Watch dog timer which forces a defined mode/state transition if an intended event does not occur within a specified timeframe.

Alpha Cubesat Systems on During Modes / States

FROM	TO	Electrical Power System (EPS)	Communications System (COMM)	Data Management System (DMS)	Structures & Mechanisms	Attitude Determination & Control System (ADCS)	Guidance, Navigation & Control System (GN&C)	Propulsion System	Thermal System	Primary Payload Encoded Bit Stream	Scar for Secondary Payload
OFF											
ACTIVATION											
BOOT											
LOAD CODE											
DEPLOY											
DETUMBLE											
POINTING											
SAFE											
CHECKOUT											
PLAN TRAJECTORY											
EXECUTE TRAJECTORY MANEUVER											
VERIFY TRAJECTORY											
PLAN COMMUNICATIONS											
EXECUTE COMMUNICATIONS LINK											
VERIFY COMMUNICATIONS											

Alpha CubeSat Systems, Subsystems & Required Services

Propulsion System (PROP)

- Hybrid Motor Oxidizer Tank Subsystem
 - Custom, Aerojet MPS-120XL CubeSat High-Impulse Adaptable Modular Propulsion System (CHAMPS) a 2U x 1U hydrazine propulsion system used to scale
 - IVA/EVR Insertable Nitrous Oxide Sealed Tank/Oxidizer
 - Pressurization Control Valve
- Hybrid Motor Core Subsystem
 - Custom, Aerojet MPS-120XL CubeSat High-Impulse Adaptable Modular Propulsion System (CHAMPS) a 2U x 1U hydrazine propulsion system used to scale
 - Thrust Control Valve
 - Injector
 - Igniter
 - Combustion Chamber Aluminized Paraffin Fuel Core
 - Hybrid Engine Nozzle
- Ion Thruster Subsystem
 - Solid Iodine Propellant Store (Qty=4)
 - Activation Control Switch (Qty=4)
 - Neutralizer Power Processing Unit Feed System (Qty=4)
 - Thrust Control Switch (Qty=4)
 - Busek BIT-1 Ion Thrusters (Qty=4)

Data Management System (DMS)

- Bus Control Subsystem
 - Blue Canyon Technologies XB1 Module
 - Processor
 - Memory
 - Storage
 - Control Logic (Software)
 - Radiation Shielded USB Boot Key
 - Near Real Time State Model Generator (Software)

Ground Systems (GS)

- Spacecraft Control Center (Virtual Web Based Control Center)
 - Spacecraft Near Real Time State Model Generator & Status Display
 - Capture & store required navigation bits
 - Spacecraft Operators
 - Internet VLAN (to authorized locations with authenticated operators)
 - Automated Command Sequence Generation and Verification Tool
- Payload Operations Center (Virtual Web Based Operations Center)
 - Payload Near Real Time State Model Generator & Status Display
 - Capture and store Cube Quest Challenge encoded bit stream
 - Payload Operators
 - Internet VLAN (to authorized locations with authenticated operators)
 - Automated Command Sequence Generation and Verification Tool

Guidance, Navigation & Control System (GN&C)

- Blue Canyon Technologies XB1, integrated
- Bus Control Subsystem
 - Blue Canyon Technologies XB1 Module
 - Bus functionality for GN&C, EPS, TCS, DMS, COMM, and Solid State Relays
 - Interfaces and control provided for Payloads, PROP, and EPS Solar Array Subsystem
 - Micro Star Tracker
 - Power Controller
 - Battery
 - GPS
- Attitude Determination & Control Subsystem
 - Blue Canyon Technologies XACT Module
 - Micro Star Tracker
 - Reaction Wheels (Qty=3)
 - Magnetometer
 - Torque Rods (Qty=3)
 - Course Sun Sensor
 - MEMS Gyro

Structures & Mechanisms (S&Mech)

- Post Solar Reflectarray Panel Hinge PZ
- Post Solar Reflectarray Panel Hinge PN
- Post Solar Reflectarray Single Axis Articulation Servo
- Post Solar Reflectarray Deployment Mechanism
- Post Solar Reflectarray Mount
- TIB Spacecraft Deployment Mechanism Attach Point
- Passive Power Source Inhibit Mechanism (EPS)
- 1U x 3U Ram/Forward Plate Structure
- Mechanical Oxidizer Tank Seal
- 2U x 3U Core Structural Spars, Rails & Plate
- Scar for Partial Aft Plate + Hybrid Rocket Ejection
- Starboard Solar Reflectarray Panel Hinge SZ
- Starboard Solar Reflectarray Panel Hinge SN
- Starboard Solar Reflectarray Single Axis Articulation Servo
- Starboard Solar Reflectarray Deployment Mechanism
- Starboard Solar Reflectarray Mount

Payload Systems (PS)

- Primary Payload Subsystem (PPS)
 - CubeQuest Challenge Encoded Bit Stream Generator
- Secondary Payload Subsystem (SPS)
 - System Performance Data Capture & Return
 - Deep Space & Lunar Data Capture & Return
 - Memorial Spaceflight Canisters

Communications System (COMM)

- Tethers Unlimited SWIFT-KTX Programmable K Band Transceiver
- Avionics Subsystem
- Software Defined Radio Subsystem
- Reflectarray Antenna Subsystem
 - Clyde Space 6U CubeSat SIDE Solar Panels (6) or equivalent with integrated reflectarray antenna
- Ground Stations
 - NASA DSN 34m BWG Ka Band 32 GHz Downlink Standard Service Baseline
 - Alternate Ground Station Ka Band 32 GHz Uplink is baselined
 - NASA DSN 34m BWG S or X Band Uplink and corresponding alternate ground station services are a defined option if required

Electrical Power System (EPS)

- Battery Subsystem
 - Blue Canyon technologies XB1 Module Battery
- Solar Reflectarray Subsystem
 - Clydespace 6U Solar Panels (Qty=6) with Reflectarray Antenna added
- Power Management And Distribution Subsystem
 - Port Power Distribution Bus linked to BCT XB1 Module
 - Starboard Power Distribution Bus linked to BCT XB1 Module
 - Source Manager Control Interface
 - Load Manager Control Interface

Thermal Control System (TCS)

- Heat Loads to Dissipate
 - EPS Passive Dissipation
 - PROP Passive Dissipation
 - GN&C Passive Dissipation
 - COMM Passive Dissipation
 - S&Mech Passive Dissipation
 - DMS Passive Dissipation
 - PS Passive Dissipation
- Tools to Move Heat
- Tools for Mitigating and/or Rejecting Heat

Launch Service Provider (LSP) Systems

- Earth-to-LEO Launch Vehicle
- Upper Stage/Trajectory Insertion Bus (TIB)
- TIB Fairing (if applicable)
- ACS Transportation Packaging

KEY:

Baseline Subsystem

Primary Interface

Safety Critical

Highlight

Optional