UASat Systems-Level Requirements

Revised: Tuesday, August 11, 1998

Key:

UASat Teams:

- PGD: Power Generation and Distribution
- DCH: Data and Command Handling
- GNC: Guidance, Navigation and Control
- TTC: Tracking, Telemetry and Command
- SCI: Science
- MSA: Mechanical Structures and Analysis

Requirement Types:

- CR: Constraint
- FR: Functional Requirement
- OR: Operational Requirement

(Note – missing numbers denote requirements removed after internal review)

01-PGD Solar Panels must provide satellite power in the range of 20-35W, with a 28v continuous bus voltage.

02-PGD Panels must operate under extreme temperature changes expected on orbit (-100ºC to 100ºC).

04-PGD Solar panels must be able to function under radiation environment expected in UASat orbit (5Krad total dose).

06-PGD Life span of solar panels must be at least the expected duration of UASat orbital lifetime.

07-PGD Solar panels must provide the required power in the specified orbit of UASat (400km, 51.6º inclination).

08-PGD Heat radiated from panels must be isolated from sensitive components on the satellite.

11-PGD All signal and power wires used must be twisted pair to minimize electromagnetic interference.

12-PGD Solar cells should be wired to allow bypassing of defective or shadowed cells.

13-DCH CR: The DCH system must operate at a speed adequate to handle all data storage and command handling procedures.

14-DCH CR: The DCH system must have sufficient storage space to store the operating system and other command handling software.

15-DCH FR: DCH must detect, verify and distribute commands.

16-DCH FR: DCH must provide internal housekeeping functions to monitor performance of the satellite engineering systems.

17-DCH FR: The DCH subsystem should have the ability to recover from single event upset errors and/or radiation caused bit errors.

18-DCH OR: The DCH subsystem will require a volume of 7500 CCs.

19-DCH OR: The DCH subsystem will require a power between 7-12 watts.

20-DCH OR: The DCH subsystem must be able to function under the radiation environment expected in UASat orbit (5 Krad total dose).

21-DCH OR: The DCH subsystem must be able to support a sufficient communication rate with the UASat radio groundstation.

21.5- DCH OR: The DCH subsystem must be able to support a sufficient communication rate with the Laser Uplink experiment.

22-DCH OR: The DCH subsystem must operate throughout the range of expected temperatures inside the satellite.

23-GNC Reaction Wheels: OR: Shall operate for expected orbital lifetime of UASat (1 year minimum)

24Reaction Wheels: FR: Shall be capable of achieving the slew rates required by the Science and STI teams

25-Reactions Wheels: FR: Shall be sized such that only 1 to 2 momentum dumps are required per orbit

26-GNC Reaction Wheels: OR: Shall require less than 1 Watt of power

27-GNC Reaction Wheels: OR: Shall require an operating temperature range of 0-50ºC

28-GNC Reaction Wheels: ER: Shall have a non-operating temperature range of -20 to 70ºC

29-GNC Reaction Wheels: CR: Shall occupy interior S/C volume equal to 4 cylinders with OD of 10 - 20 cm and height of 5 - 10 cm

30-GNC Sun Sensors: FR: Shall require an accuracy of +/- 5%

31-GNC Sun Sensors: OR: Shall require 0.5 Watts while operating and 1 mW in power down mode

32-GNC Sun Sensors: CR: Shall require 6 3x4 cm areas of the outer satellite surface

33-GNC Magnetometer: CR: Shall occupy internal satellite volume equal to 4.45 x 14.3 x 7.62 cm = 485 CCs

33.5-GNC Magnetometer: OR: Shall not be located near sources of stray magnetic fields

34-GNC Magnetometer: CR: Shall have mass of 0.5 kg

35-GNC Magnetometer: OR: Shall require an average of 0.7 Watts of power

36-GNC Magnetometer: CR: Shall require an operating temperature range within -30 to 60ºC

37-GNC GPS: OR: Shall require approximately 1 Watt of power

38-GNC GPS: CR: Shall occupy volume equal to 5 x 8 x 2 cm = 80 CCs

39-GNC GPS: CR: Shall require area on outer surface of satellite for antennae placement

40-GNC Micro-mechanical Gyros: OR: Shall require approximately 1 Watt of power

41-GNC Micro-mechanical Gyros: CR: Shall occupy volume equal to 1.5 x 1.5 x 3 cm = 6.75 CCs

42-GNC Horizon Sensor: OR: Shall require power (most likely around 1 Watt)

43-GNC Horizon Sensor: CR: Shall require some area on the outer satellite surface with the same view as the science instrument.

44-TTC OR: TNC must be able to downlink a Quadrature Phase Shift Keying (QPSK) modulated signal up to a maximum speed needed to get all science and telemetry data acquired for up to 4 passes within a standard pass of 7 minutes.

45-TTC FR: TNC must be able to decode a command uplink signal of 9600 bps with QPSK modulation.

47-TTC FR: Downlink power amplifier must transmit at a minimum of 400mW in order to allow the groundstation to receive an adequate signal.

49-TTC OR: Downlink antenna must have a gain greater than or equal to 10dB in order to downlink an adequate signal and ease power requirements needed during downlink.

50-TTC FR: Downlink antenna must be able to transmit the maximum power the downlink power amplifier can output.

53-TTC FR: TNC must be able to handle a full duplex Pacsat session at the standard AMSAT rate of 9600 bps Frequency Shift Keying (FSK) modulation.

55-TTC FR: Pacsat amplifiers must be able to handle 100% duty cycle with less than 1% efficiency degradation in order stabilize power requirements and keep downlink at a constant signal strength.

56-TTC ER: DSPs in TNC must be able function under radiation environment expected in UASat orbit (5Krad total dose).

59-TTC FR: Downlink antenna must not have a half-power beam width less than 13 degrees in order to ease pointing requirements on GNC

60-SCI FR: The science instrument must detect and count lightning flashes on the Earth, as viewed from orbit.

61-SCI FR: The science instrument must detect and count sprites, as viewed from orbit.

62-SCI FR: The science instrument must measure stellar emissions through the standard Johnson UBVRI filter set.

63-SCI FR: The science instrument must detect and count lightning flashes at night; it may need to detect and count lightning flashes during daylight.

64-SCI FR: The science instrument must detect and count sprites at night; it may need to detect and count sprites during daylight and moonlight.

65-SCI FR: The science instrument may need to obtain spatially and chronologically resolved sequences of images of sprite phenomena.

66-SCI OR: The instrument field of view must encompass at least the size of one mesoscale convective system.

67-SCI OR: The instrument must be able to distinguish between the emitted radiationfrom sprite phenomena and the emitted radiation from lightning phenomena.
67.5-SCI OR: The instrument must be able to distinguish sprite radiation from auroral emissions.

68-SCI OR: The instrument must be inertially pointed at a predefined sequence of targets spanning a range of astronomical coordinates and luminosities.

69-SCI OR: The instrument must detect and count lightning flashes during a sufficient time period to distinguish seasonal variations.

70-SCI OR: The instrument must detect and count sprites during a sufficient time period to distinguish seasonal variations.

71-SCI OR: Spatial and chronological resolutions of approximately 10 km and 8msec respectively may be required.

72-SCI CR: Must meet predefined size and mass constraints.

75-MSA CR: Entire structure must not exceed 19.75 inches in diameter or be more than 28.25 inches high in order to fit in the Hitchhiker Ejection Canister.

76-MSA FR: Structure must contain an opening for the optics aperture

77-MSA FR: Structure must anchor, protect, and help provide an environment conducive to instrument and subsystem operating tolerances.

78-MSA FR: Satellite must have a marmon plate to interface with the Hitchhiker ejection system.

80-MSA OR: Structure must withstand 3 g's during launch with a safety factor of 1.4

81-MSA FR: Structure must be able to radiate excess thermal energy.

82-MSA FR: Outer structure must be able to support solar panels.

83-MSA FR: Basic finite analysis reveals that an inner telescope tube will be the major load bearing structure.