CLARREO DAC-5 Mission Architecture Overview (Preliminary) **6/4/2010**

The CLARREO project is currently in an information gathering phase and conducting market research to better assess industry's capabilities. We are conducting engineering trade studies internally to determine the feasibility of flying the payload instruments on smaller class launch vehicles to thoroughly explore the trade space. This document identifies the payload accommodation requirements to support those trade studies. CLARREO's Mission Concept Review (MCR) is preliminarily scheduled for late 2010. However, the results of the engineering trade studies and the payload accommodation requirements defined in this document may not be incorporated into the concept presented at MCR. In addition, we have not developed or received approval on a procurement strategy. This document is posted at the CLARREO website: http://clarreo.larc.nasa.gov.

For the purposes of the trade studies, the CLARREO mission is envisioned to consist of two launch opportunities with preliminary launch readiness dates (LRD's) of 2017 and 2020. For the launch in 2017 or CLARREO 1, there will be one observatory carrying a payload of one infrared (IR) instrument suite and a GNSS Radio Occultation (RO) instrument system or an observatory carrying one reflected solar instrument suite and a GNSS RO instrument system. Either observatory configuration is under consideration for the launch in 2017 for CLARREO 1. For the launch in 2020 or CLARREO 2, there will be two observatories. One observatory would consist of an infrared (IR) instrument suite and a GNSS RO instrument system and the second observatory would consist of a reflected solar instrument suite and a GNSS RO instrument system.

The reflected solar instrument suite consists of two spectrometers which will be co-boresighted, combined into a single instrument suite and mounted to the spacecraft by means of a single-axis gimbal to enable nadir (nominal operations), off-nadir reference inter-calibration observations, lunar verification and Solar calibration observations. The single-axis gimbal is assumed to be part of the payload. The GNSS-RO system is considered a science instrument; the spacecraft bus would be expected to provide an independent means for acquiring any required observatory position information. The payload instruments, related hardware, and software elements shall be considered to be provided by the government. The GNSS-RO will require a total of three antennas integrated on the ram, wake, and zenith faces. The zenith face antenna will be a precision orbit determination (POD) antenna. The IR instrument suite will be pointed with respect to the spacecraft bus nadir deck by an instrument internal mirror to enable nadir, off-nadir, internal calibration, and deep-space (zenith) observations. The following pages describe the payload accommodation requirements for the Infrared Instrument Suite / GNSS-RO and Reflected Solar Instrument Suite / GNSS-RO Observatories.

Payload Accommodation Requirements	CLARREO	CLARREO
	IR / GNSS-RO Observatory	RS / GNSS-RO Observatory
Mission Parameters:		
Science Objectives	CLARREO will measure spectral reflected solar energy, emitted infrared radiances and Global Navigation Satellite System (GNSS) Radio Occultation (RO) refractivities. These measurements will be used to detect climate change trends and test, validate, and improve climate prediction models. The CLARREO mission will provide accurate, credible, and tested climate change records that lay the groundwork for informed decisions on mitigation and adaptation policies that address the effects of climate change on society.	
Launch Requirements:		
Nominal Orbit	LEO	LEO
Mean Orbit Altitude (Km) +/- 200 meters	609	609
Inclination	90	90
Orbit Period Control	(+/-) 0.25 seconds	(+/-) 0.25 seconds
Design Operational Life	3 Years	3 Years
Estimated Launch Readiness Date (LRD)	2017, 2020	2017, 2020
CBE Instrument Sizes (m)	IR instrument: .88 x .70 x .80 GNSS-RO Receiver: .19 x .12 x .23, Ram/Wake antennas: .46 x .77 x .076, POD antenna: .31 diameter x .10 tall	RS instrument: .90 x .70 x .40 GNSS-RO Receiver: .19 x .12 x .23, Ram/Wake antennas: .46 x .77 x .076, POD antenna: .31 diameter x .10 tall
Launch Site Requirement	Capablility to support 90 degree orbit insertion	Capablility to support 90 degree orbit insertion
Observatory Not Too Exceed (NTS) mass (kg)	505	505
Launch vehicle dynamic envelope assumption (inches)	61	61
Science and C&D Handling		
Science Downlink Format	CCSDS	CCSDS
Science Data Downlink Frequency	X Band	X Band

Average Science Data Rate (Mbps)	0.23	1.00
Maximum Science Data Rate (Mbps)	0.232	164
Command & State of Health (SOH) links	S-Band	S-Band
Onboard Data Storage (Gb/Day & # of days)	1 day @ 47Gb/Day	1 day @ 139 Gb/Day
Payload Mass		
CBE Instrument Mass (Kg)	91	93
Mass margin	30%	29%
Total Instrument Mass Allocation (CBE+Margin) (kg)	118	120
Payload Power		
CBE Operational orbit average	154	143
Power Margin	30%	30%
Total Instrument Power Allocation (CBE+Margin)	200	187
Bus Voltage	28	28
Field of View (FOV)	- IR Zenith FOR: ±5° cone w.r.t. Zenith - IR Off-Zenith FOR ±5° cone -IR Nadir FOR: ±5° cone w.r.t. nadir-GPS-RO Ant #1: centered 65° w.r.t. nadir, ±10° in Nadir-Ram plane, ±45° out of plane -GPS-RO Ant #2: ±75° cone w.r.t. zenith -GPS-RO Ant #3: Centered 65° w.r.t. nadir, ±10° nadir-wake plane, ±45° out of plane	-Solar FOR: +125° TO -125° w.r.t. nadir in S/C roll axis -GPS-RO Ant #1: centered 65° w.r.t. nadir, ±10° in Nadir-Ram plane, ±45° out of plane -GPS-RO Ant #2: ±75° cone w.r.t. zenith -GPS-RO Ant #3: Centered 65° w.r.t. nadir, ±10° nadir-wake plane, ±45° out of plane
Attitude Control		
Pointing Knowledge (3 sigma)	<0.02 degree or 72 arc sec	<0.02 degree or 72 arc sec
Pointing Accuracy (3 sigma)	<0.1 degree or 360 arc sec	<0.1 degree or 360 arc sec
Jitter (3 sigma)	<0.01 degrees or 36 arc sec	<0.01 degrees or 36 arc sec

Drift (3 sigma)	<0.01 degrees or 36 arc sec over 0.1 second	<0.01 degrees or 36 arc sec over 0.1 second
ACS	3-Axis	3-Axis
Orbit Knowledge	30 m	30 m
GPS Receiver	Minimum 1	Minimum 1
Star Trackers	Minimum 1	Minimum 1
Instrument Thermal Requirement		
Thermally isolated	Yes	Yes
Propulsion	5 years Mission Capability	5 years Mission Capability
	Monopropellant - No Bi-proprellants for contamination concerns	Monopropellant - No Bi-proprellants for contamination concerns
Observatory Environmental & Facility (driven by Instrument)		
NASA Risk Classification	Class C	Class C
EMI/EMC	GSFC 7000	GSFC 7000
Vibe	GSFC 7000	GSFC 7000
Tvac	GSFC 7000	GSFC 7000
Radiation	GSFC 7000	GSFC 7000
Cleanroom Class	10K	10K
Special Facilitiy Needs	none	none