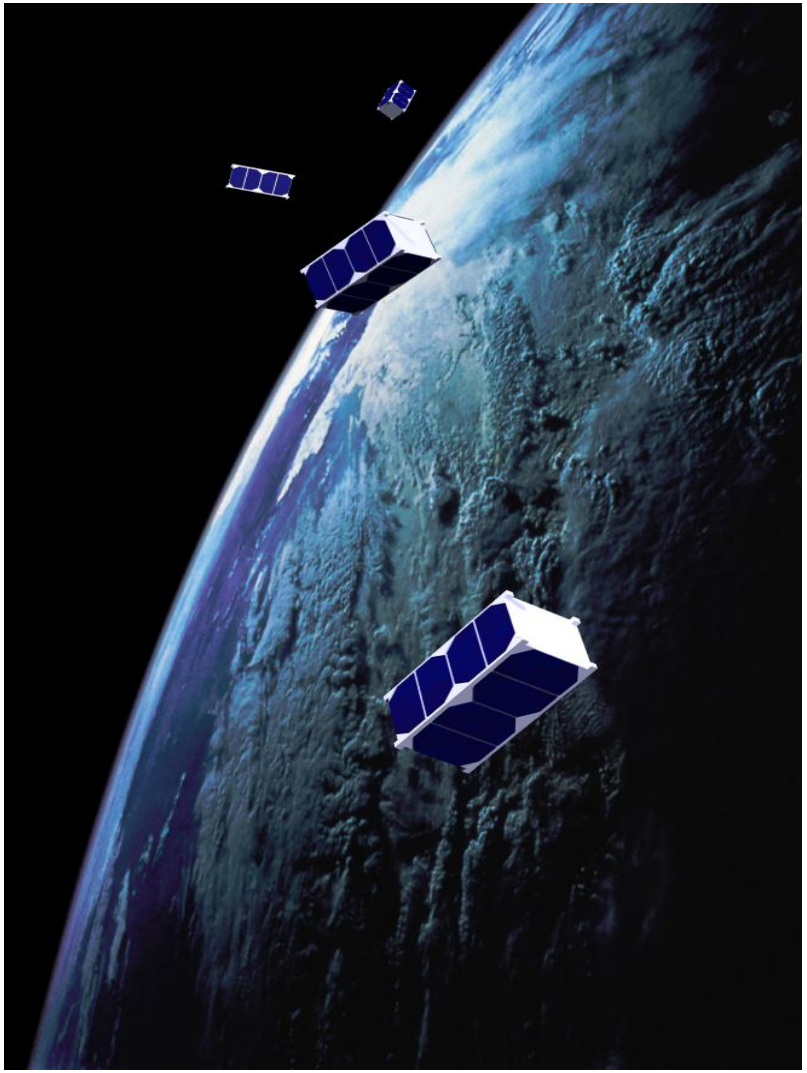
QB50

System Requirements
[updates from Issue 3]



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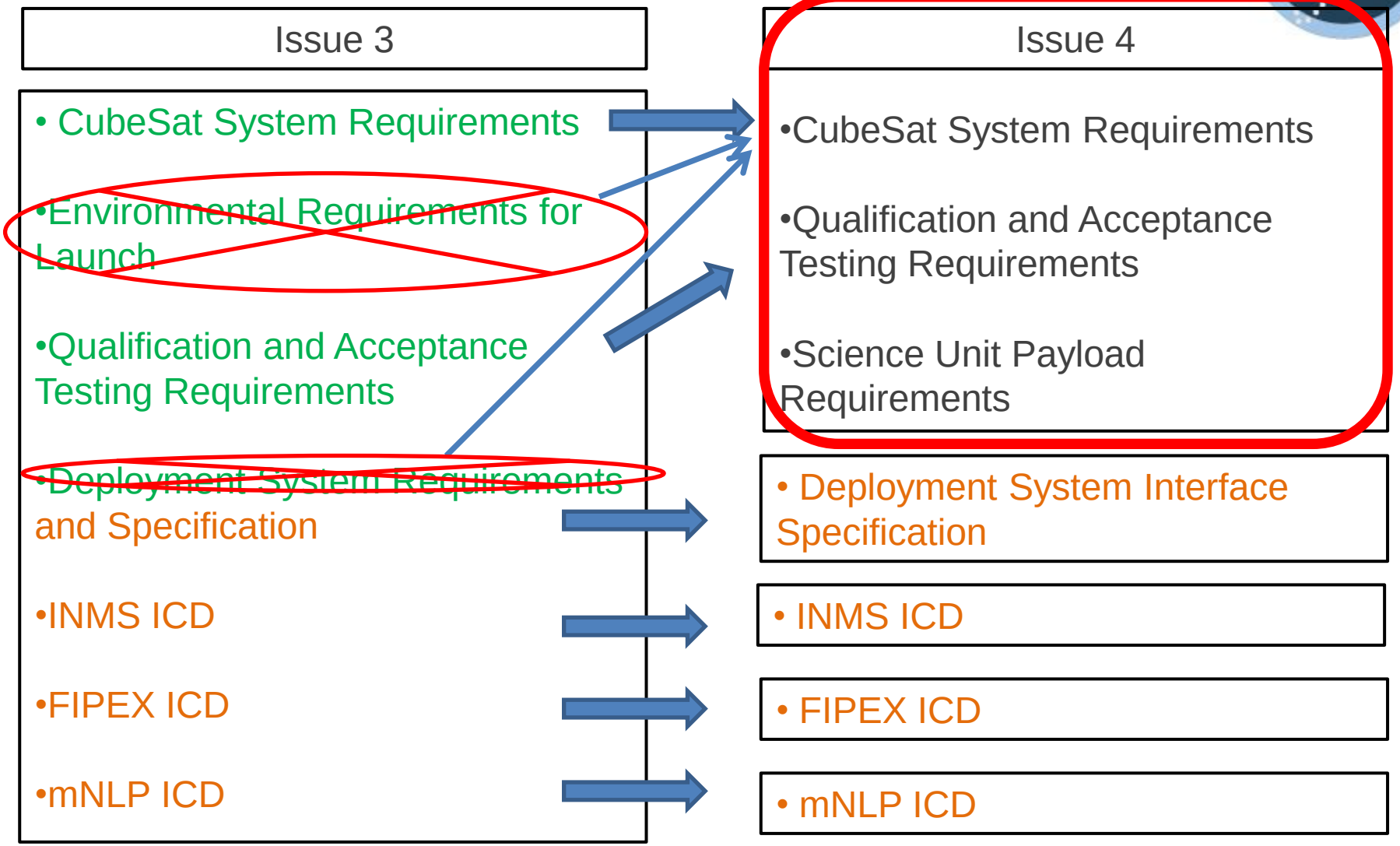
6th QB50 Workshop
6 June 2013
Rhode-Saint-Genèse, Belgium

Structure of Document



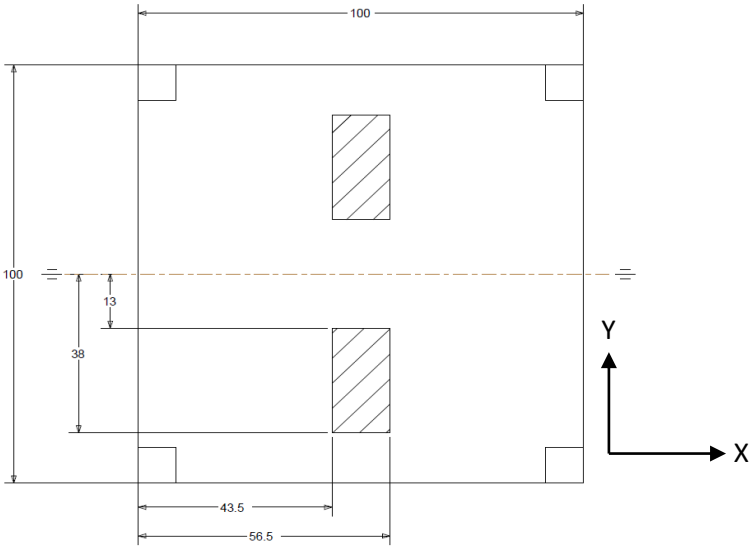
CubeSat Sys. Req.

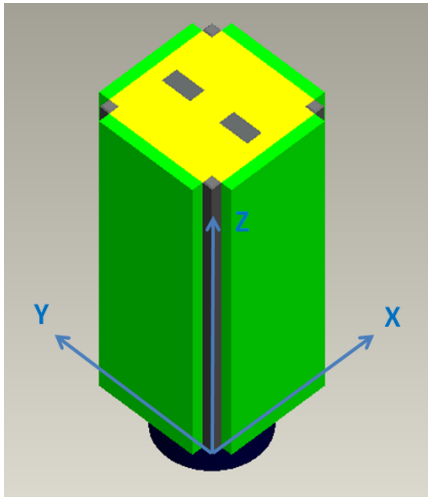
Structure

- CalPoly CubeSat Design Specification
  - *Does apply*
  - *In case of conflict, QB50 requirement supersedes*

- CubeSat access hatch defined on +Z face
  - *25mm x 13mm slots x 2*

- CubeSat coordinate system defined
  - *Same as deployment system*





Issue 4

- CubeSat System Requirements
- Qualification and Acceptance Testing Requirements
- Science Unit Payload Requirements

CubeSat Sys. Req.

ADCS

- Removed pointing knowledge (±2°) and pointing accuracy requirement (±10°)
  - *-Moved to Science Unit Payload Requirement section*
- Added a more general attitude requirement
  - *-Vector normal to the face with the SU shall be in the spacecraft ram velocity direction*

EPS

- No modification from Issue 3

Issue 4

- CubeSat System Requirements
- Qualification and Acceptance Testing Requirements
- Science Unit Payload Requirements

CubeSat Sys. Req.

OBC/OBDH

- Modified memory storage requirement
  - *Reduced from 2GB to 45MB*
- Additional Whole Orbit Data (WOD) requirement
  - *WOD shall be downloaded*
  - *should not be overwritten before being downloaded*
- Defined OBC clock reference
  - *….contaning seconds since ZERO Day defined as 01.01.2014 00:00:00 UTC*

Thermal

- No modification from Issue 3

Issue 4

- CubeSat System Requirements
- Qualification and Acceptance Testing Requirements
- Science Unit Payload Requirements

CubeSat Sys. Req.

Downlink

- Added a constraint on downlink frequency
  - *VHF shall not be used for downlink*

VHF Frequency allocation
- VHF ~200 kHz
- ISS ~ 50 kHz
- Available for QB50 ~150 k Hz

Based on QB50 PDR results
- 19 VHF uplink
- 7 VHF downlink (9.6 baud) → each ~30 kHz
- VHF downlink required for QB50 > 200 kHz

- Removed science data volume downlink (2Mbits / day)
  - *Moved to Science Unit Payload Requirements Section*

Issue 4

- CubeSat System Requirements
- Qualification and Acceptance Testing Requirements
- Science Unit Payload Requirements

CubeSat Sys. Req.

Downlink

- Removed requirement on unique identifier of downlink signal
  - *QB50-SYS-1.5.6*
    ….Every downlink signal shall carry a unique identifier of which satellite is transmitting.
- By default, AX.25 UI protocols requires destination and source
- Modified protocol requirement to include UI Frames
  - *QB50-SYS-1.5.15*
    ….The CubeSat shall use the AX.25 Protocol.
- *The CubeSat shall use the AX.25 Protocol (UI Frames)*

Issue 4

- CubeSat System Requirements
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CubeSat Sys. Req.

Downlink

- Frequency stability requirement has been merged / relaxed
  - *QB50-SYS-1.5.3*
    ….shall ensure….stable to better than ±500Hz…
  - *QB50-SYS-1.5.4*
    ….shall fit in 16kHz at -30 dBc, without doppler…
  - *QB50-SYS-1.5.5*
    ….shall be better than 10ppm…

- *If UHF is used for downlink, the transmission shall fit in 20 kHz at -30 dBc, measured without Doppler, but over the entire temperature range.*

Issue 4

- CubeSat System Requirements
- Qualification and Acceptance Testing Requirements
- Science Unit Payload Requirements

CubeSat Sys. Req.

Uplink

- Radio cessation requirement has been merged / relaxed
  - *QB50-SYS-1.5.8*

    …..All CubeSats shall have the capability to receive a transmitter shutdown command at all times ~~later than 30 minutes~~ after the CubeSat's deployment switches being activated from deployer ejection

  - *QB50-SYS-1.5.13*

    ….CubeSats shall be fitted with devices to ensure immediate cessation of their radio emissions by telecommand, whenever such cessation is required under the provisions of these Regulations. (This requirement is adopted from the ITU).

Issue 4

- CubeSat System Requirements
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CubeSat Sys. Req.

Uplink

- Removed position and time tag requirements
  - *QB50-SYS-1.5.11*
    …..science packet shall be tagged with the position of the CubeSat at the time that the RDY line goes high….

  -QB50-SYS-1.5.12
    …. science packet shall be tagged with the real time that the RDY line goes high….

- *RDY line no longer exits*

- *Moved position and time tag requirements to Science Unit Payload Requirements section*

Issue 4

•CubeSat System Requirements

•Qualification and Acceptance Testing Requirements

•Science Unit Payload Requirements

CubeSat Sys. Req.

- Few additions to this section
  - *moved from Deployment System section in Issue 3*

•If a CubeSat has any special requirement in terms of cleanliness, handling, storage or shipment, these shall be communicated to the deployer integrator (ISIS BV) 12 months before delivery of the CubeSat and also highlighted in the User Manual.

•The CubeSats should have a dedicated case for transport and storage.

•The CubeSat name shall be printed, engraved or otherwise marked on the CubeSat and visible through the access hatch in the door of the deployer.

Issue 4

•CubeSat System Requirements

•Qualification and Acceptance Testing Requirements

•Science Unit Payload Requirements

CubeSat Sys. Req.

- Few more additions to this section
  - *Moved from Environmental Requirements*

Contamination

•The CubeSat shall withstand a total contamination of 3.1mg/m^2 (TBC before CDR) at all phases of the launch vehicle ground operation and in flight.

EMC

•During prelaunch processing and launch, the spacecraft onboard equipment and ground support equipment (GSE) shall sustain the electromagnetic fields of up to 10V/m (TBC) within 10 kHz to 40 GHz.

Issue 4

•CubeSat System Requirements

•Qualification and Acceptance Testing Requirements

•Science Unit Payload Requirements

Qual & Accpt. Testing Req.

- Quasi-static and g-loads
  - *12g in all three axis*
- Resonant frequency
  - *> 90 Hz*
- Sinusoidal vibration
  - *Levels specified in document*
- Random vibration
  - *Levels specified in document*
- Shock
  - *Levels specified in document*

Modified from Issue 3
- An envelope from the considered the LVs

Issue 4

- CubeSat System Requirements
- Qualification and Acceptance Testing Requirements
- Science Unit Payload Requirements

Science Unit Payload Req.

	INMS	FIPEX	mNLP
Attitude	±2° knowledge ±10° control	±2° knowledge ±20° control	±5° knowledge ±15° control
Data Volume	2Mbits / day	0.3 Mbits / day	2Mbits / day
Humidity		-	< 20%
Position Tag		On receiving a science or telemetry packet from the science unit, the OBC shall attach the following information within 200 ms (TBC before CDR) after receiving the first Byte to it: current real time, current spacecraft attitude and position. The full packet shall be stored in the OBC Mass Memory for later request of transmission to ground. The format of this packet is defined in the corresponding science unit ICD.	On receiving a science or housekeeping telemetry packet from the mNLP science unit, the OBC shall attach the following information within 500 ms (TBC) after receiving the first Byte of the packet: Current real time, current spacecraft attitude and position. The full packet shall be stored in the OBC Mass Memory for later request of transmission to ground. The format of this packet will be defined in the mNLP science unit ICD before the end of August 2013
Time Tag			
Attitude Tag			

Issue 4

- CubeSat System Requirements
- Qualification and Acceptance Testing Requirements
- Science Unit Payload Requirements

Conclusion

- Documents have been split accordingly
  - CubeSat System Requirements
  - Deployment System Interface Specification
  - INMS ICD
  - FIPEX ICD
  - m-NLP ICD

- Updates from Issue 3
  - CubeSat system requirements – modified, added, merged / deleted
  - Environmental chapter mostly deleted – contamination and EMC
  - Qual & Acceptance Test section – updated to have a launch envelope
  - Deployment System section removed; req. moved to CubeSat system req.
  - Science Unit Payload section added

- Issue 4 CubeSat System Requirements
  - Will be ready by 13 June 2013 on QB50 website

Thank you for your attention!