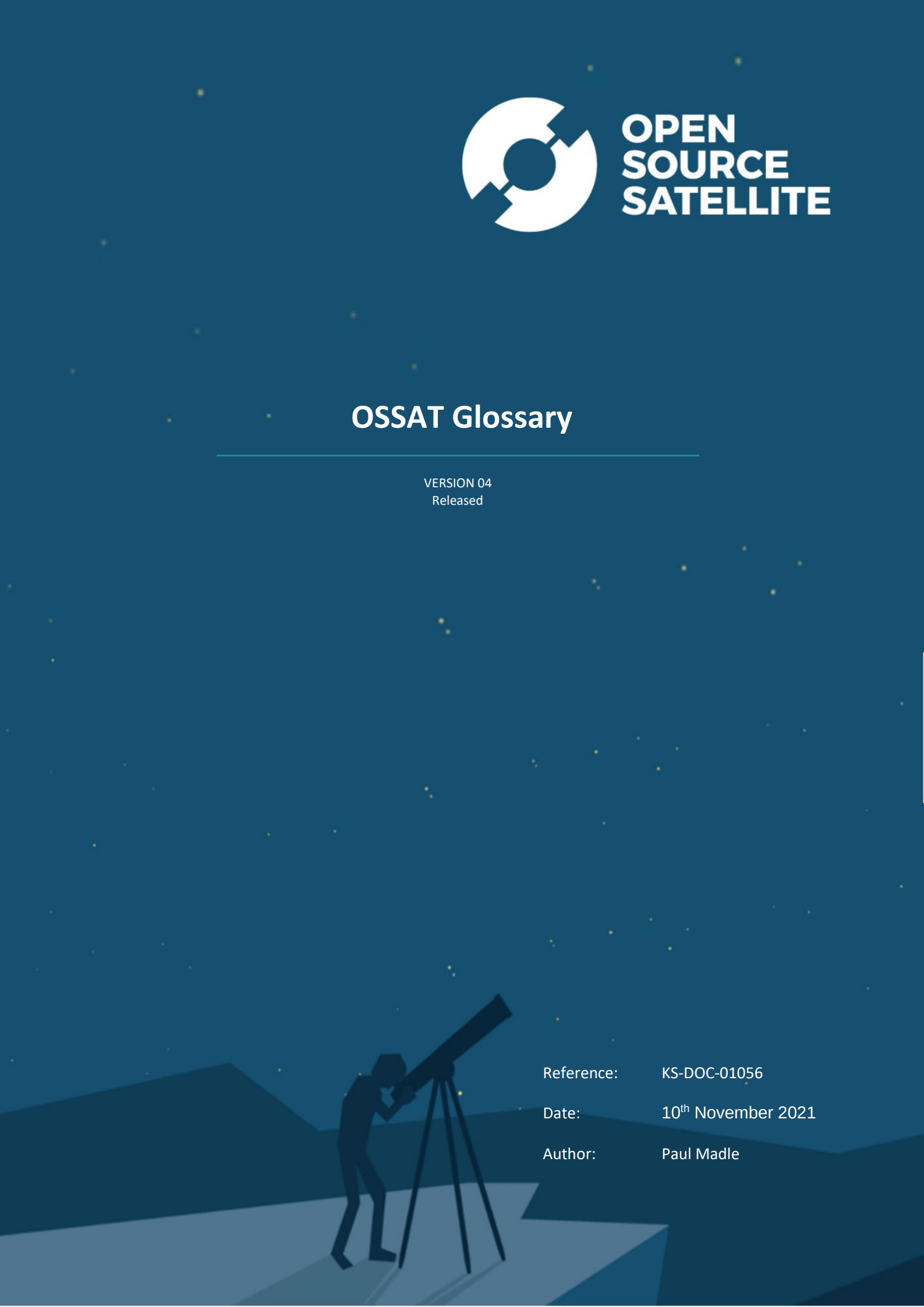


OSSAT Glossary

VERSION 04
Released

Reference: KS-DOC-01056

Date: 10th November 2021

Author: Paul Madle

Table of Contents

Glossary & Acronyms

Term	Meaning
AI	Artificial Intelligence
AOCS	Attitude Orbit Control System
AOCS Configuration File	This is a file that includes definitions for: Moments of Inertia Conditions for transitions between AOCS modes Control Constants Orientation of sensors & actuators.
AOCS Mode	This is the current attitude control mode. Attitude control modes can straddle multiple functional modes. e.g. The Functional Mode: Safety Mode might include AOCS Modes: Detumble and Sun acquisition.
AOCS log	A log file designed to allow an operator visibility of AOCS performance and anomalies.
ARQ	Automatic Re-Request
Absolute Time Operational Timetable	This is an operational timetable where events are scheduled relative to an absolute time. e.g. time that the operator desires to take an image of the ground.
Acoustic Testing	Acoustic testing is a type of environmental testing that is conducted on the Open Source Satellite. It is a dynamic test and it involves subjecting the satellite to intense noise levels (to simulate the launch environment) whilst monitoring its vibration response.
Application	The application is the exploitation that the customer wants to achieve. The Open Source Satellite could be used as part of the solution to achieve this application. An example application could be the detection and alerting of forest fires. The application is going to drive the needs of the system that the customer requires.
BIT	Built In Test
Backlog	The backlog is the location for features which have been driven by system functions that are not going to be implemented in the current variant of the Open Source Satellite. The features on the backlog may inform the strategic roadmap going forward.
Boundary Crossing Agencies	Boundary crossing agencies could be considered to be a collective of individuals or bodies which are not geographically located within a single country or controlled by a single government. An example of this could include the United Nations.
CAE	Command And Error
CCSDS	The Consultative Commitee for Space Data Systems
CDR	Critical Design Review
Collaborator	A collaborator is a member of the Open Source Satellite Community that contributes to the open source repository.
Command and Error log	The command and error log holds all of the commands coming into the spacecraft through either the command line interface or through the in orbit TTC. It also holds the command responses as well as all errors that are generated by the software.
Commercial	A commercial customer could be considered to be an entity which is looking to make financial (or other) gain from the system.
Concept of Operations	The concept of operations (CONOPS) describes how the Open Source Satellite could be used to achieve a specific application. The customer may provide the CONOPS or it may need to be developed in conjunction with the customer. The CONOPS will help inform the mission and may need to be refined based upon any mission constraints that are fed back. The resulting CONOPS will inform some of the test cases that need to be run to verify that the Open Source Satellite will perform the activities that are required.

Configurable Parameters	Parameters that are not compiled into the spacecraft software but are later uploaded to a spacecraft to define mission specific behaviors. The idea is that the software stays the same between missions and the mission specific configuration is held in a file to save time in development and verification on future missions.
Constellation	A constellation can be considered as two or more satellites that, collectively, fulfil a specific application or mission.
Continuous Integration	A method by which changes to a product are automatically re-verified to ensure that changes are not breaking existing functionality.
Cost	Every programme of work that is undertaken inherently has a cost. This cost can be comprised of materials and labour. The scope of what is being undertaken and the time available to do the work drives the cost.
Critical Telemetry	Telemetry points that are captured at all times and are particularly helpful for anomaly diagnosis.
Current Objective	The current objective is the milestone or aim that the Open Source Satellite Programme is currently trying to achieve.
Customer	The customer is someone who wants to implement a specific application and the Open Source Satellite may form part of the solution. They may perform a number of roles within the context of the Open Source Satellite, for example, they may be the payload provider; or they may provide instructions to the other entities that perform those roles. They may have a concept of operations (CONOPS) that they can pass on to inform the mission. The degree to which they drive the solution may be dependent upon whether they are an existing space entity or a new entrant to the space market.
DVB-S2	Digital Video Broadcasting - Satellite - Second Generation.
Dependency	With respect to code, a dependency is where one piece of code depends upon the existence and inclusion of another piece of code. In C, this is achieved through a “#include”.
EA	Enterprise Architect
ECC	Error Correcting Code (with reference to electronic memories that can correct themselves to single bit-flips)
Educational	An educational customer could be considered to be an entity which is either, or closely related to, an academic institution.
Electromagnetic Compatibility / Susceptibility Testing	Electromagnetic compatibility / susceptibility testing is a type of environmental testing that is conducted on the Open Source Satellite. It can be made up of different aspects: • Conducted emissions and susceptibility: the intent of this testing is to verify that the emissions produced by the satellite (when powered) are below the mask limits imposed by the launch agency; it also verifies that the satellite survives and remains in a safe state when exposed to a conducted emissions mask as set by the launch agency • Radiated emissions and susceptibility: the intent of this testing is to verify that the satellite emissions fall below the mask limits imposed by the launch agency; it also verifies that the satellite survives and remains in a safe state when exposed to a conducted emissions mask as set by the launch agency and facility • Self-susceptibility: the intent of this testing is to verify that the satellite systems, when operating in a flight representative mode, do not cause mutual interference that might impact safety, functionality or performance.
Enumeration	An enumeration is used in any programming language to define a constant set of values. For example, the days of the week can be defined as an enumeration.
Environmental Testing	Environmental testing is one facet of the qualification which the Open Source Satellite will be subjected to. It comprises: • Electromagnetic compatibility / susceptibility testing • Thermal vacuum testing • Acoustic testing

	• Temperature testing • Vibration testing
Existing Space Entity	An existing space entity is a type of customer who already has either a) previously procured a 3rd party satellite b) built their own satellite or c) previously made use of the Open Source Satellite.
Exploiter	The exploiter is considered a member of the Open Source Satellite Community and will be making use of the Open Source Satellite for their own purposes. They could be the customer (although this is not a requirement).
FPU	Floating Point Unit
FRR	Flight Readiness Review
Follower	The follower is considered a member of the Open Source Satellite Community. Their role is considered to be an interested party in the material in the repository which they will read. Should they undertake activities with the material in the repository then their role may migrate to that of being a collaborator or exploiter.
Functional Mode	This is a mode of a computer within a Satellite. They include Operational, Safety, Idle, Monitoring, Off, In Reset. This is not to be confused with a system level spacecraft mode which describes the mode of the spacecraft as a whole.
Future Objective	The future objective is a milestone or aim that the Open Source Satellite Programme will look to satisfy in the future.
Geostationary Orbit	A geostationary orbit (GEO) is a circular orbit which is 35,786km above the Earth's equator and follows the direction of the Earth's rotation. From the ground, an object in a geostationary orbit appears to be in a fixed position in the sky, motionless.
Geosynchronous Orbit	A geosynchronous orbit is an orbit around the Earth which matches the rate at which the Earth rotates. This means that, from the ground, the object in the geosynchronous orbit, returns to the same point in the sky after a period of one sidereal day (~23 hours, 56 minutes and 4 seconds). A geostationary orbit is a special case of geosynchronous orbit.
Git	A version control tool used to maintain versions of code during and following development.
Government Body	A government body is considered to be a collective which is controlled by a single government. An example of this could include the British Government or the UK Space Agency.
Ground Segment	The ground segment is the aspect of the system which provides the interface between the Open Source Satellite and user. It communicates with the Open Source Satellite, and is controlled by the operator. The ground segment makes the obtained data available to the user. It needs to satisfy the appropriate regulations as set by the regulatory body.
Ground Station	A terrestrial facility that communicates with a Spacecraft via a radio link. Ground Stations monitor the Telemetry of the Spacecraft, as well as send Telecommands and upload and download files.
Historical Telemetry	A feature on board the spacecraft that performs telemetry capture to on board memory for later download to the ground.
Hosted Functions	Functions that are hosted by a computer on board the spacecraft.
Incremental Methodology	A term that describes the software development process. See the OSS Software Development Process for further information.
Institutional	An institutional customer can either be a new entrant to space market or an existing space entity. It is considered to either be boundary crossing agencies or a government body.
Integration Testing	This is testing the software once integrated into the electronics and with varying levels of the integrated system.
Integrator	An integrator is responsible for the amalgamation of the Open Source Satellite by combining the Open Source Satellite Platform and the Payload (or payloads).
Interplanetary Orbit	An interplanetary orbit is an orbit which goes between celestial bodies (for

	example between the Earth and Mars).
Jenkins	An open source tool developed to aid the administration of continuous integration
KISPE Space	KISPE Space is the originating company associated with the Open Source Satellite Programme. It sets the vision for the programme and develops the Open Source Satellite Programme, in conjunction with the Open Source Satellite community.
Kicker	This is a code construct or error that has been known to make the source code vulnerable to bugs.
Lab Environment	The lab environment is one of the environments that the Open Source Satellite needs to be operable in. The lab environment is likely to be more benign than the other environments that the Open Source Satellite will see, for example with respect to temperature and air pressure. However, there will still need to be a level of qualification undertaken to verify that the system will work under lab conditions.
Launch Environment	The launch environment is one of the environments that the Open Source Satellite needs to be able to survive / operable in should it be powered at launch. The launch environment is likely to drive a degree of the dynamic testing (such as vibration testing) since it is likely to be the largest component of this environment. The launch environment will vary depending upon the launch conditions (such as the launch vehicle being used). Therefore, a level of qualification will need to be undertaken to verify that the system will work under these conditions.
Launch Provider	The launch provider is the owner of the launch vehicle used to get the Open Source Satellite into its desired orbit. They may have a manifest of multiple different satellite for a single launch. The Open Source Satellite needs to satisfy requirements that are set by the launch provider in order to be allowed to launch on their system.
Launch Vehicle	The launch vehicle is the mechanism used to get the Open Source Satellite into its desired orbit. It may launch more than one satellite (of which there may be more than one Open Source Satellite). The selection of the launch vehicle determines in part, what the launch environment will be like.
Low Earth Orbit	A Low Earth Orbit (LEO) is a orbit which is between 160km and 2000km. There are a range of orbit types within the LEO definition, including circular and polar. Due to their altitude and orbit time, from the ground, an object in a LEO will move across the sky (direction dependent upon the orbit type).
MBU	Multi-Bit Upset
MMU	Memory Management Unit, used to segregate processor memory.
Malicious 3rd Party	A malicious 3rd party is an entity that may attempt to disrupt the Open Source Satellite Programme. This could involve impacting the community aspect or the satellite aspect (or both).
Manufacturer	A manufacturer is responsible producing one or more of the physical components of the Open Source Satellite. They may be producing them under license (thus considered in house) or making them independently (considered external).
Medium Earth Orbit	A Medium Earth Orbit (MEO) is a orbit which is between 2000km and less than 35786km. Due to their altitude and orbit time, from the ground, an object in a MEO will move across the sky (direction dependent upon the orbit type).
Mission	The mission is the series of operations performed by the Open Source Satellite over its lifetime to achieve the application required by the customer. It is in part derived from, and also influences, the concept of operations and drives the test cases that need to be performed to validate that the Open Source Satellite will meet the required needs. The mission will drive the orbit selection.
Need	The need is derived from a number of sources but primarily from the application that the customer desires. The needs are broken down into system functions which are at a level where they can be achieved by a specific system element (platform, payload or ground segment). The test cases derived from the concept

	of operations, mission and application are used to validate the need.
New Entrant to Space Market	A new entrant to space market is a type of customer who has not previously procured or built a satellite (3rd party satellite or Open Source Satellite).
OSS	Open Source Satellite
OSS_COMMAND_LINE	A compilation definition specific to the Open Source Satellite project. If defined at compile time, the software BIT and housekeeping task will launch a command line interface that can be used to command and interrogate the platform computer.
Object	An object in the software refers to a software unit that has both function and data. For example, an AOCS object might have functions to change TLE and have data that stores the moments of inertia. Objects can contain functions that are the main loop for a task. In this case, the Objects name is appended with "Task". See the Extended Glossary for further details.
Objective	The set of objectives associated with the Open Source Satellite Programme are derived from the strategic roadmap. The set of objectives satisfy the vision which has been set. An objective can be defined as either a current objective or a future objective.
Open Source Satellite	The Open Source Satellite is a type of satellite and forms a facet of the Open Source Satellite Programme. It is comprised of the Open Source Satellite platform which has been developed as part of the Open Source Satellite Programme and a payload (or multiple payloads). The integration of these two elements (platform and payload) is undertaken by an integrator. It is controlled by an operator who communicates with it via the ground segment. It will be put through a qualification regime to satisfy that a) it will perform as required when operational and it b) meets the requirements of the regulatory body.
Open Source Satellite Community	The Open Source Satellite Community forms a facet of the Open Source Satellite Programme. There are a number of different types of stakeholders who make up the Open Source Satellite Community who all have varying degrees of involvement and input into the overall programme. All members of the Open Source Satellite Community have degrees of access to the repository where information relating to the Open Source Satellite is stored.
Open Source Satellite Platform	The Open Source Satellite platform is developed as part of the Open Source Satellite Programme. It is one part of the Open Source Satellite and it provides an interface to the payload. It is integrated with the payload to form the Open Source Satellite by the integrator.
Open Source Satellite Programme	The Open Source Satellite Programme encompasses everything relating to the development of the Open Source Satellite and the corresponding community. The programme is under the development of KISPE Space and is intended to meet the high level objectives set (which is comprised of the current objectives and then any future objectives). The future objectives may revise the Open Source Satellite Programme. The Open Source Satellite Community interacts with the programme in different ways depending upon their level of involvement.
Operational Environment	The operational environment is one of the environments that the Open Source Satellite needs to be able to survive / be operable in. The orbit that the mission is conducted in helps to inform what the operational environment will be. For example, this environment is likely to drive the thermal vacuum environmental testing that is undertaken. Therefore, a level of qualification will need to be undertaken to verify that the system will work under these conditions.
Operational Timetable	This is a list of commands (also containing forms of conditional logic) that is run on board the spacecraft in order to perform operations. These are uploaded from the ground and are an output from ground based mission planning.
Operator	An operator is responsible for controlling the Open Source Satellite using the ground segment.
Orbit	The orbit is the definition of where the Open Source Satellite is placed in order to achieve its mission. The orbit selected informs the operational environment within which the Open Source Satellite needs to operate.

PDR	Preliminary Design Review
PUS	Packet Utilisation Standard
PWM	Pulse Width Modulator
Package	A package refers to an Enterprise Architect artefact that holds diagrams and other artefacts. See the Extended Glossary for further details.
Partner	The partner is considered a member of the Open Source Satellite Community and will be working on the development of the Open Source Satellite Programme.
Payload	The payload is part of the Open Source Satellite but not developed as part of the Open Source Satellite Programme. Its development is conducted by the payload provider (who could potentially be the customer). It is a facet of the system and interfaces with the Open Source Satellite platform. There could be multiple payloads to a single platform. Example payloads could include optical cameras, science experiments or broadcast signal detection hardware. It is integrated with the platform to form the Open Source Satellite by the integrator.
Payload Provider	The payload provider develops the payload which forms a part of the Open Source Satellite. They could be the customer or a 3rd party. If the customer is not the payload provider then the customer would instruct the payload provider as to what is required.
Physical Component	The need(s) that are identified which are to be undertaken by the Open Source Satellite are devolved into a series of system functions, then recursively decomposed into system features. The system features can be realised onto a single physical component, with each component potentially able to satisfy multiple features. An example physical component could be a data recorder or a mechanical structure. The choice of physical components is validated by the test cases which have been derived.
Platform	The Open Source Satellite platform is developed as part of the Open Source Satellite Programme. It is one part of the Open Source Satellite and it provides an interface to the payload. It is integrated with the payload to form the Open Source Satellite by the integrator. The spacecraft platform is *almost* everything needed to support a payload in space: • Ensures Power Safe Operations • Attitude Control, points the body of the spacecraft to an accuracy required by the payload • Provides *limited* power • Provides physical enclosure for the payload • Provides any necessary thermal conditioning required for the payload.
Platform Processor	The main processing unit within the OSS spacecraft platform with overall control of the spacecraft.
Portable	Portable code can be re-authored quickly onto different hardware architectures or to use different RTOS and file systems.
Pull request	This is an operation supported by Git where the developer is requesting that element of work they have undertaken be reviewed ahead of being integrated into the master trunk
QSPI	Quad Serial Peripheral Interface
Qualifer	A qualifier is responsible for performing the qualification that the Open Source Satellite will undergo. It may involve multiple different types of qualifier for the different types of qualification to be undertaken.
Qualification	Qualification is required to validate that the Open Source Satellite is going to perform as expected under the various conditions it is exposed to and that it meets the needs of the regulatory body. The type and level of qualification is informed by the launch environment, operational environment and the lab environment as well as the needs of the regulatory body. One facet of qualification testing is environmental testing.

RTC	Real Time Clock
RTOS	Real Time Operating System
Re-entrant	This is an attribute of a “C” function. Reentrant functions are those that can be entered from multiple tasks, ISRs, threads simultaneously. They tend to be stateless.
Real time telemetry	Real time telemetry is telemetry data that is streamed to the ground with no ARQ whilst the spacecraft is in sight of a groundstation.
Real time telemetry traffic lights	This is a concept where real time telemetry points are grouped together into functional groups, each group is associated a "traffic light" that can be used as a visual aid on the ground to help the operator understand the overall health of that subsystem.
Regulatory Body	The regulatory body encompasses all parties which have rules or regulations that will impact the development of the Open Source Satellite. Both the Open Source Satellite and the ground segment are required to satisfy the relevant regulatory body. There may be a number of bodies which are relevant. The different needs that these bodies have will impact the qualification that needs to be conducted and the design of the platform.
Repository	The repository is the collation of all the material relating to the Open Source Satellite Programme and can be accessed by members of the Open Source Satellite Community. There are different types of interactions with the repository - there can be 'read only' actions where material is accessed but no material is committed to the repository, or a 'read/write' relationship where material is accessed and new material is also submitted.
Rollover	This is where a number represented by a fixed number of bits rolls over from a maximum value back to 0.
SEU	Single Event Upset
Safety Locked Code Upload	Code upload is possible in all spacecraft modes. However: under certain modes, code upload is restricted so that upload is only possible when enabled by command. The idea is to: - Ensure operators upload with caution. - Ensure that accidental upload is restricted.
Satellite	Satellite is the general term for what the Open Source Satellite is a type of. It performs a mission and this can either be undertaken using a single satellite or multiple satellites in a constellation. The satellite, regardless of type, is launched using a launch vehicle (which may contain more than one satellite). The design, build and operation of the satellite is obligated to satisfy the relevant regulatory body.
Schedule	Every programme of work that is undertaken works to a schedule, either formally or informally. The schedule details when activities will take place and the resourcing required for each activity. The scope of what is being undertaken, as derived by the schedule, drives the cost. The schedule in turn is driven by the vision that has been set.
Sponsor	A sponsor is a member of the Open Source Satellite Community and they make a significant contribution to the Open Source Satellite Programme. This could be financial support.
Strategic Roadmap	The strategic roadmap is the overarching plan for the Open Source Satellite Programme. It is derived from the vision that has been set and is used to set the goal(s) that are to be achieved. The features that end up on the backlog may help inform any changes to the strategic roadmap that are required or should be considered.
Supporter	A supporter is a member of the Open Source Satellite Community and they support the objectives of the Open Source Satellite Programme.
System	The Open Source Satellite is comprised of three systems: the ground segment, payload and the Open Source Satellite platform. The Open Source Satellite platform is the focus of the development under the Open Source Satellite Programme. The definition of the aspects of the system is driven by the system

	functions which have been derived from the needs of the various stakeholders based on the different applications.
System Feature	A system feature is the decomposition of system functions to an appropriate level such that they can be allocated to a single physical component. This is a recursive decomposition and the result may be that several system features, when combined, fulfil a single system function. Test cases will validate the system features derived. If a system feature is not to be implemented straight away it will be placed onto the backlog.
System Function	A system function is the decomposition of needs to an appropriate level such that they can be allocated to a single aspect of the system (ground segment, payload or Open Source Satellite platform). It may be that several system functions when combined, fulfil a single need. The system functions will then be decomposed into system features. Test cases will validate the system functions derived.
TRR	Test Readiness Review
Task	This describes a scheduled unit of software. Tasks share processor execution time so that the software runs in a multi-tasking fashion. The RTOS performs the necessary context switching to run the tasks.
Task object	The is an object that contains the main loop of a task.
Technology Demonstrator	A technology demonstrator can be considered a satellite that is being used to pipe clean or demonstrate functionality, provide proof of concept or flight prove hardware.
Telecommand	A command sent from a Ground Station to a Spacecraft. I.e Switch on GPS Receiver, or Switch AOCS Mode to Sun Tracking. The Spacecraft should respond once it has actioned the Telecommand Request, this is called a Telecommand Response.
Telemetry	A data point sent from the Spacecraft to a Ground Station. This could be stats about the Spacecraft itself, i.e Temperature, Battery Charge. Due to limitations with the radio link, usually only critical data is transmitted constantly without stimulus from the ground. Therefore a Ground Station can ask for a particular Telemetry point via sending a Telemetry Request. The response from the Spacecraft with a Telemetry point is known as a Telemetry Response.
Temperature Testing	Temperature testing is a type of environmental testing that is conducted on the Open Source Satellite. It is a dynamic test and it involves subjecting the satellite to a temperature range whilst performing tests, monitoring the satellite response and performance.
Test Case	Test cases are used to validate the needs, system functions, system features and physical components that comprise the system. The test cases are driven by the application, concept of operations and mission aspects.
Thermal Vacuum Testing	Thermal vacuum testing is a type of environmental testing that is conducted on the Open Source Satellite. It is a dynamic test and is coupled with thermal testing so that it involves subjecting the satellite to representative pressure and temperature environments, whilst performing tests, monitoring the satellite response and performance.
Triggered Operational Timetable	A triggered timetable is one that is triggered from an event e.g. - OBC boot up for the first time. - A switch is closed - A telemetry point goes out of bounds. - A spacecraft mode change occurs - An absolute time is hit. Some support is given to conditional logic and execution looping.
Trunk	The actively used, main development branch, code and design that is in development is on a brank. When it is accepted, it is merged into the trunk.
UML	Unified Modelling Language (a set of notations typically used to model software designs).

Unreachable (code)	This is code that can never be executed (and cannot be tested)
User	A user can be a member of the Open Source Satellite Community and makes use of data that has been collected by the Open Source Satellite via accessing the ground segment aspect of the system.
Vibration Testing	Vibration testing is a type of environmental testing that is conducted on the Open Source Satellite. It is a dynamic test and it involves subjecting the satellite to specific vibration levels monitoring its response and validating operation post test.
Vision	The vision for the Open Source Satellite Programme is derived from the strategic roadmap. The vision drives the schedule and cost of the programme. The goals which are defined satisfy the vision set.
barricading	This is a technique used to limit the range of values passed between the incoming I/O interface and the rest of the software (see extended glossary for further details).
branch	A version control action that allows sideline developments to occur whilst maintaining a known "master" branch.
cold start	This describes a power up event and the initialisation that occurs following the application of power.
contributor	An individual who volunteers their time to develop aspects of the open source satellite.
warm start	This term describes when a system/chip goes through a reset and restart whilst power is applied (i.e. the circuitry is warm).

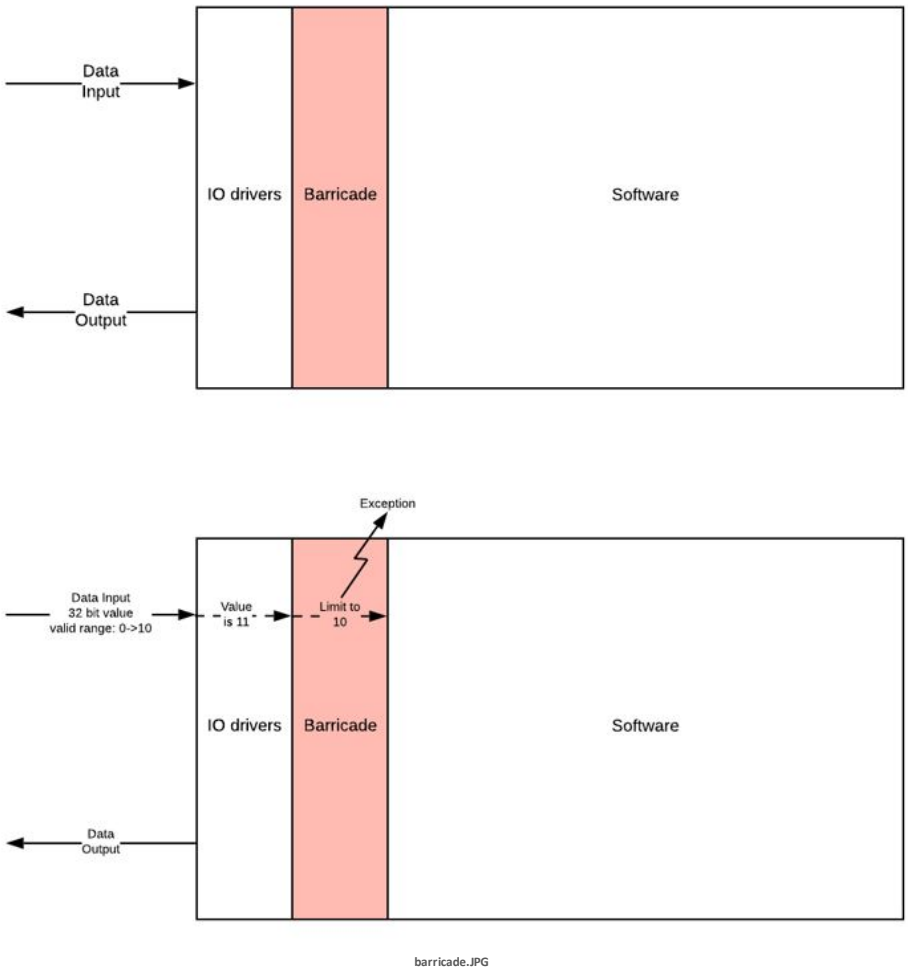
Extended Glossary

This section gives a supplementary explanation of terms as used in the open source satellite program. Diagrams are provided in order to clarify terminology.

Barricading

This is a technique in coding that limits the amount of variable limit checking to the region of code close to the I/O interface.

Barricading is a technique that ensures that data coming into the software system is range checked on the way in (somewhere close to the IO drivers). When the data is received, it passes through a software barricade that range checks the incoming data and either raises exceptions or ensures that levels cannot be exceeded.
Once through the barricade, the rest of the software does not need to range check the incoming values.
The following diagrams illustrate this.



barricade.JPG

Figure 1: Barricading

Object

The relationship between the term "object" and the term "task" is further explained in the following diagram.

In this example, an object exists called "DataFormatter". This is generic code that can be used by other code to reformat data from one form to another. This object has a function "DF_ReformatData" that is required by 2 other objects. Since DataFormatter is not scheduled by itself, it relies upon other objects to call it, it does not contain the main loop of a task and is therefore not a task object.

2 other objects, AOCSTask and HistoricalTelemetryTask both contain "Run" functions that are the main loops of 2 different tasks, they are therefore considered to be task objects. Both of these "Run" functions are scheduled by the RTOS.

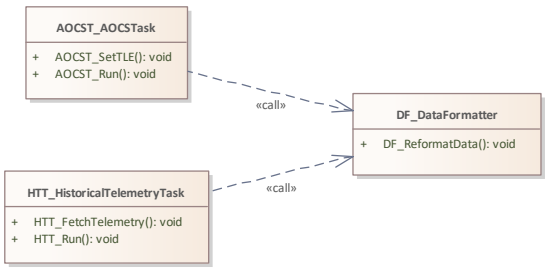


Figure 2: Object and tasks

Package

Packages have been used within the Enterprise Architect model to provide structure and hierarchy. As illustrated in the figure, under the model there are a number of packages which have been used to split the model into sections and provide hierarchy. As an example, Model Guidance is a package which contains all elements relating to how to use the model. It can be seen that there are a number of elements within the Model Guidance package, these include a series of diagrams and artefacts. Numbering has been used to help denote hierarchy

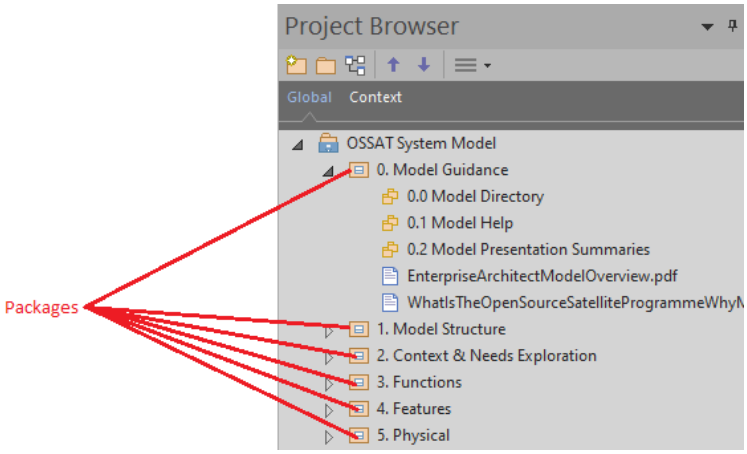


Figure 3: Package

www.opensourcesatellite.org

linkedin.com/company/open-source-satellite

@SatelliteOpen

info@opensourcesatellite.org