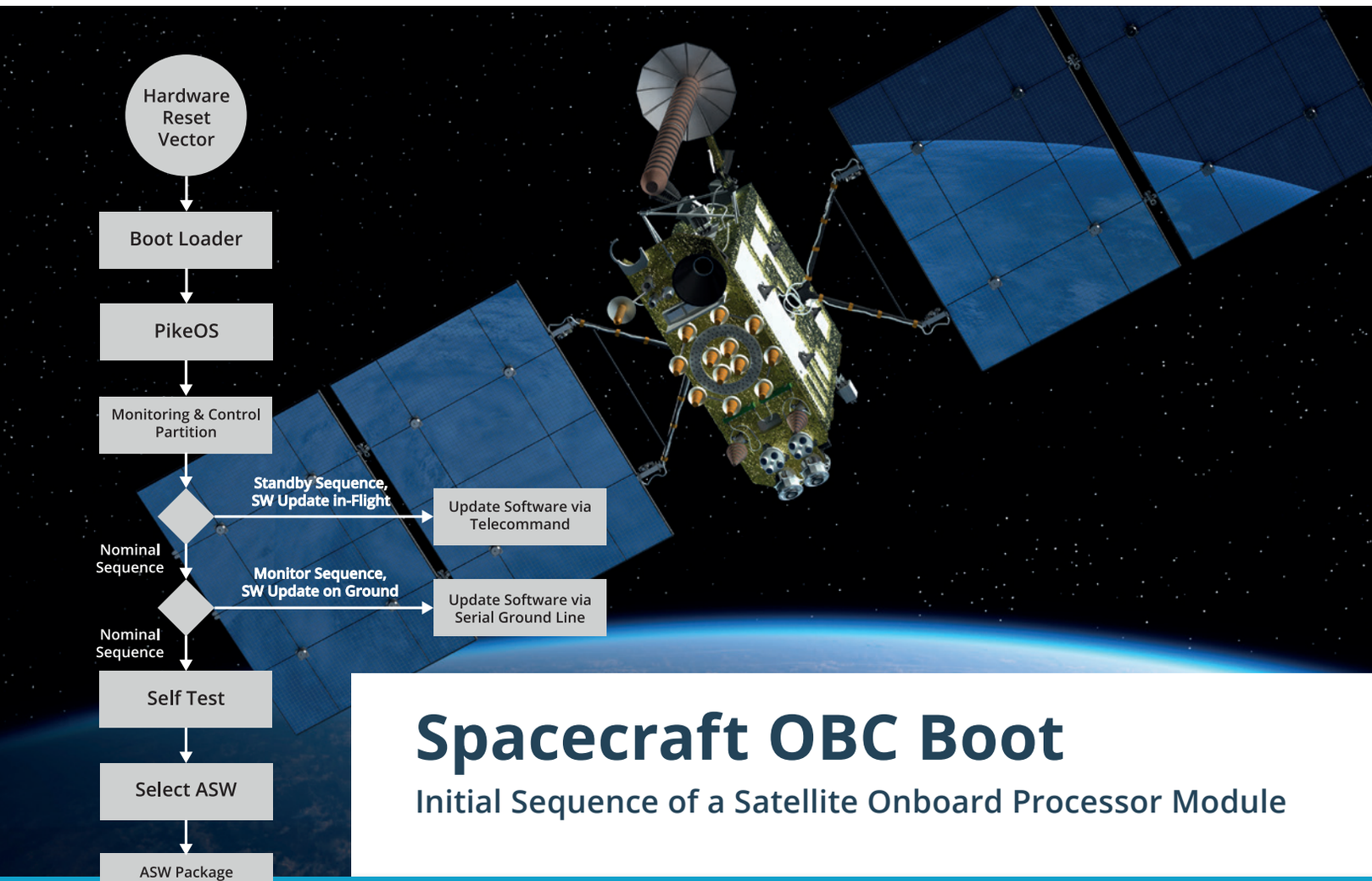
SYSGO
EMBEDDING INNOVATIONS



Spacecraft OBC Boot

Initial Sequence of a Satellite Onboard Processor Module

PikeOS RTOS & Hypervisor

Space Avionics Systems ready for Future Missions

Figure 1 shows the startup sequence of a satellite onboard processor module. Once the board has been powered up, the boot loader is the first software part to be started. The boot loader typically executes sanity checks and copies the operating system software from read-only memory to RAM. Afterwards the control is passed over to the operating system (OS). In the course of this use case description, PikeOS is being used.

PikeOS is a lightweight real-time capable hypervisor that provides virtualization by means of partitioning. Each partition is independent and isolated from other partitions in terms of memory, I/O and processor time. However, PikeOS allows to grant privileged permissions to dedicated partitions, enabling those to monitor and control other user partitions.

* OBC = Onboard Computer System

Figure 3 shows a software architecture typically used within space missions, where the control and monitor partition is the the first application that is being started from the operating system. This application checks the boot software mode and continues in one of three different ways:

1. Nominal Sequence **2. Standby Sequence** **3. Monitor Sequence**

The nominal sequence is considered as normal startup. After executing the self-test, the control partition selects one of the application software (ASW) images. The number of available ASW images is configurable, but the minimum number of available packages is always two. ASW images are located in read-only memory that is mapped into the address space of the control partition only. This allows the control partition to perform integrity checks on the selected image.

If the integrity check succeeds, the control partition copies the image into the address space of the related user partitions by means of the PikeOS shared memory mechanism and performs a final integrity check on the copied data. Finally, the control partition starts the user partitions.

The monitor sequence is similar to the standby sequence, but is used on ground only. It does not impose a requirement on the other processor module. Also, the communication may use faster communication busses. The monitor sequence also allows operations such as load, dump and check processor memories as well as firmware updates.

The standby sequence is used during space flight and applicable to one of the two redundant processor modules which must be in inactive mode (see Figure 2). During the standby sequence, the other processor module is expected to be active and has successfully passed the nominal sequence in order to manage the spacecraft's orbital maneuvers.

During the standby sequence, the control and monitor application may receive telecommands from the inter-processor link and perform operations such as load, dump and check processor memories. The control application may also execute an update of one of the inactive application software images.

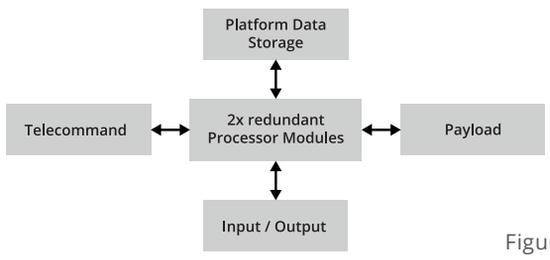


Figure 2

PIKEOS SOFTWARE ARCHITECTURE

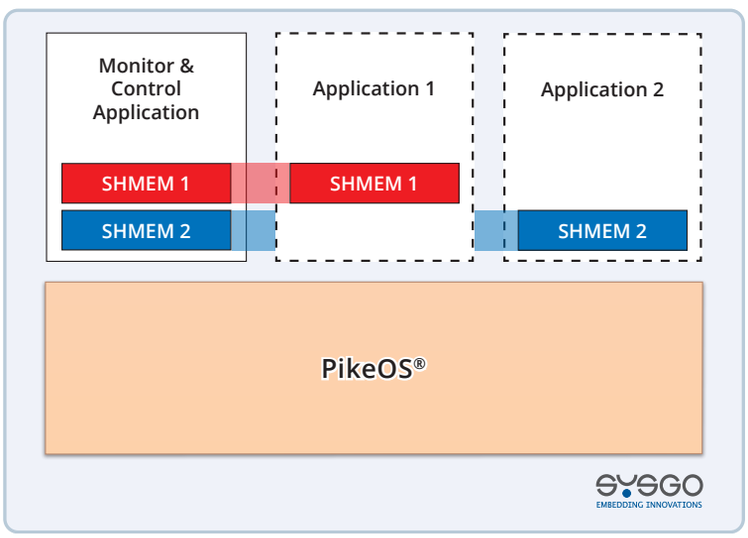


Figure 3

Founded in 1991, SYSGO became a trusted advisor for Embedded Operating Systems and is the European leader in hypervisor-based OS technology offering worldwide product life cycle support. We are well positioned to meet customer needs in all industries and offer tailor-made solutions with highest expectations in Safety & Security. More information at www.sysgo.com/space

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