Linux For Space
Mission Begins

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#Linux4Space2022

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What is Linux For Space?

- Collaborative open source project.
- It was founded with the intention of creating an open source Yocto based Linux distribution suitable for the space applications.
- The project brings together all the stakeholders: the software and hardware developers, the suppliers, and technology companies.
- The Linux4Space is designed to be compliant with the ESA Standards (ECSS - European Cooperation for Space Standardization) and it is based on community defined requirements.

The Linux For Space has started in February 2022.
Who are we?

- Embedded Linux specialists at Technical University of Liberec.
- From 2017 we have delivered 4 fully customized embedded Linux distribution to our industry partners working mostly in automotive.
- In our last project called BusKit we have implemented full CI/CD chain for Yocto based development called *Embedded TULChain*.
- We are experienced Requirements engineers with more than 20 years industry experience.
- We have consulted several space Linux solutions.
Why are you here?

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Why Linux For Space just now?

- Hardware starts to be ready for Linux.
- More and more Linuxes in space.
- Each of them is customized by HW supplier.
- Now we face similar situation as Automotive Linux +-5 years back ago.

Now it is the right time to build together the space ready Linux distribution!
What can bring the open space ready distribution?

- Space is strictly defined use-case.
- The system has to fill typical set of requirements.
- The system shall be compliant to space industry standards.

Why to reinvent the wheel with each new cubesat?
# Linux in space history

<table>
<thead>
<tr>
<th>Name</th>
<th>Operator</th>
<th>Launch date</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>QuakeSat</td>
<td>QuakeFinder LLC</td>
<td>2003</td>
<td>Diamond Systems Prometheus PC/104 x86 CPU module with Red Hat Linux</td>
</tr>
<tr>
<td>MidSTAR-1</td>
<td>United States Naval Academy</td>
<td>2007</td>
<td>ARM Linux on a payload controller</td>
</tr>
<tr>
<td>STRaND-1</td>
<td>Surrey Space Centre</td>
<td>2013</td>
<td>Digi-Wi9C with μClinux and Google Nexus One with Android</td>
</tr>
<tr>
<td>Falcon 9, Dragon</td>
<td>SpaceX</td>
<td>Several since 2010</td>
<td>Multiple COTS computers, custom Linux 3.2 with real-time patches</td>
</tr>
</tbody>
</table>

The plan
What defines the space use-case?

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What defines the space use-case?

- Radiation, a lot of radiation.
- Limited power, really limited power.
- High reliability required.
- No GUI.
- No CLI.
- If terminal, then on telemetry.
- Latency.
- Overheating.
- Hard maintenance - the systems shall work autonomously.
Mission 1: The Requirements collection

● The main goal:

  Convert use-case to set of well defined requirements.

● Regular meetings from February 2022.
● The outcome: Linux4Space requirements, ver. 001
● The document structure based on ECSS Standard (functional, interface, operational, configuration, design, verification).

ECSS-E-ST-10-06: Technical requirements specification.
Why requirements?
Requirements ver. 001 - Selected examples

● Radiation:
  ○ The system shall switch off immediately.
  ○ The system works in several parallel instances.
  ○ The filesystems shall mostly work in read-only mode.

● Interfaces:
  ○ SpaceWire, SpaceFibre
  ○ CubeSat Space Protocol

● Power constraints:
  ○ The system shall have a configuration to define the process with a certain power budget.
What do we have

- [link] linux4space.org
- Requirements version 001 (available online).
- Dictionary (available online).
- The first Yocto implementation strategy draft (not yet online).
- Regular community meetings.
Who is already involved?

Payloads for space.
Several running space realizations.
Requirements collection.

VZLUSAT-2 with Linux currently in space.
Requirements collection.

Web, project organization, propagation and management
Requirements collection
Project implementation
What has to be done? How can I participate?

- You can join the meetings to help define the requirements.
- You can help to build the reference distribution.
- You can test the Linux For Space on your device.
- Everyone is welcome to join us!
Yocto Implementation details: The Embedded TULChain

- The full CI/CD for embedded Linux development.
- Based on Gitlab.
- Containers for compilation and image preparation.
- Automated compilation and tests after commit.
- Fully traceable system from the initial configuration to final image.
- All the tests stored in database.
- Defined as IaaC, portable.

The Embedded TULChain is the outcome of the BusKit project supported by the Czech Technology Agency.
Everyone is welcome!

- Next community meeting: Thursday 22th of September at 15:00.
- Scan the code to get invitation.
How much do you like the idea of Linux For Space?
Would you like to join the community?

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For questions join us on slido.com
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Everyone is welcome!