RTEMS SMP QDP

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Activity information

- GSTP activity started in February 2019
- Consortium is composed of
  - **EDISOFT**(Portugal –consortium lead): RTEMS qualification experience, industry expertise
  - **Embedded Brains** (Germany): RTEMS SMP development expertise, community expertise
  - **LERO**(University of Limerick, Trinity College Dublin, Ireland): formal methods expertise
  - **Jena-Optronik**(Germany): end user in space domain, application qualification expertise
  - **CISTER**(Portugal): real-time software, multicores and software qualification expertise
- Investment: 700 kEuro
- Due date: Dec 2021

RTEMS in terms of ESA

- Another ESA key activities about RTEMS:
  - EDISOFT RTEMS (http://rtemscentre.edisoft.pt)
    - Based on RTEMS 4.8.0, qualified to DAL-B, applied in many space missions
    - Open source**, but qualification data pack is licensed**
    - **Single core**: ERC32, LEON2 and LEON3
    - Maintained by EDISOFT. **The new product is not replacing this version**
    - Contact EDISOFT on license cost and support contracts
  - RTEMS-SMP, available in the RTEMS mainline, part of 5.x (release) / 6.x (dev)
    - Co-developed with the RTEMS community, with significant ESA investment
    - Several device drivers made SMP compliant by Cobham Gaisler(own investment)

Objectives of the activity

- Production of a (pre-) qualification toolkit that allows end-users to qualify their (space) application software on bespoke (space-qualified) hardware:
  - **Target application is payloads** (instrument, data processing) (**TSP vs SMP**)
  - A **space subset** has been defined in the scope of the activity
  - Base-line target platforms are Gaisler reference boards:
    - **GR712RC** (LEON3 dual core)
    - **GR740** (LEON4 quad core)
  - The pre-qualification toolkit uses the **GCC-based cross-compiler provided** by the RTEMS Source Builder as baseline (**RSB -currently at GCC v10.2.1**)
  - **Alignment with the (qualified) Mathematical Library for Flight Software (MLFS)** https://essr.esa.int/project/mlfs-mathematical-library-for-flight-softwareand (under development, qualified Q4/2021)

What the QDP contains

- The Qualification toolkit contents
  - **Curated version of the source code** and related documentation, including all resources needed (i.e. compiler, build scripts) to build RTEMS itself
  - **All verification and validation evidence**, obtained from analysis, testing and proof, for the identified target configurations, in the form of documents required by **ECSS-E-ST-40C and ECSS-Q-ST-80C Rev 1**
  - **Curated test suite and all supporting resources required** to automatically execute the test suite and reproduce the test evidence for each identified target configuration
  - Set of instructions of how to use the qualification toolkit (user manual)
  - The qualification toolkit **is fully open source and free of charge**
- The activity is close to the RTEMS main-line evolution, it means less effort of maintenance

Benefits of the activity to the space industry

- Lower the cost of qualifying by providing a pre-qualified RTEMS
- Sustainable long-term solution by leveraging community support, enabling change and innovation while maintaining quality and stability
- Easy to adopt, use and maintain

The qualification data pack significantly reduces the qualification effort needed by the end-user but there is still work left to do

Where the activity are.

- The RTEMS SMP functionality is already fully functional and tested (on both GR712 and GR740)
  - They are available in the website: https://rtems-qual.io.esa.int and ESRR
- Minimal driver support included:
  - GPIO
  - UART
  - SpW. (no MIL-STD-1553 support)
- The QDP is pre-qualified to ECSS SW criticality category-C Caveat: a clause-by-clause compliance matrix for both ECSS E-40 and Q-80 is provided!
- Regular community releases (growing only in coverage completeness) of the qualification datapacks will be made until the project passes AR -to allow early adoption by end-users
- Full (dockerised) continuous integration pipe-line has been set-up in ESA TEC-SW software lab,to enable quick turn-around times for delta-certification of (any) change to the RTEMS eco-system

RTEMS SMP Qualification DataPacks

- CDR data pack: available March 2021 (SMP versions only)
  - QR1 data pack: available July 2021 (all configurations)
  - QR2 data pack: available Oct 2021 (all configurations)
  - AR data pack: available Dec 2021 (all configurations)
- Four types of qualification data packs are available
  - LEON4 –SMP (qualified on GR740 quad-core)
  - LEON4 –classic RTEMS (qualified on GR740 using a single core only)
  - LEON3 –SMP (qualified on GR712RC dual-core)
  - LEON3 –classic RTEMS (qualified on GR712RC using a single core only)

Summary

- The QDP is available in https://rtems-qual.io.esa.int/
- ESA gitlabissue tracker will be enabled for Q&A
- Complete QDP (Cat-C) is expected in Dec 2021
- Complementary ISVV activity (to lift to Cat-B pre-qualification) an ITT has been released in May of 2021

Thanks