SystemReady Compliance for Qualcomm® Platforms

Naina Mehta
Engineer,Senior
<nainmeht@qti.qualcomm.com>

SystemReady

- SystemReady compliance program aims at
  - Standardized interface between hardware and firmware
  - Standardized interface between firmware and hypervisor/OS
  - SoC maintenance in upstream Linux
  - OS to run out-of-the-box with different platforms

- SystemReady Devicetree Band, previously referred to as IR band, caters to embedded devices using Devicetree

Architecture Compliance Suite (ACS)

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- UEFI Self-Certification Tests (SCT)
  Validates UEFI protocols for availability of boot services, runtime services, loaded image protocol, devicepath protocol, console support etc.
- MVP Test
  Device tree validation – kselftest, DT schema check, ethernet tool test, block devices as boot sources
- OS Test
  Network validation and network devices as boot sources
- Capsule Update Test
- Base System Architecture (BSA) Test
  Validates system requirements such as PE functionalities, memory map, GIC, timer etc.
- Firmware Test Suite (FWTS)
  Checks for presence of a valid DT, validates UEFI runtime services

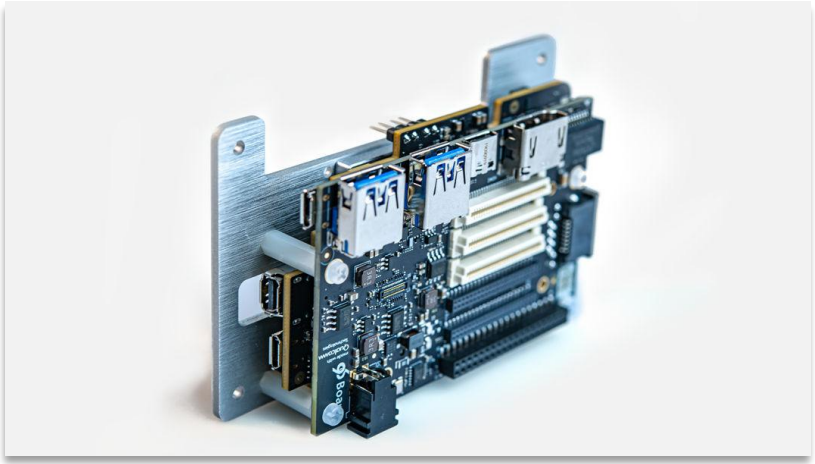
Qualcomm® Platforms

- Qualcomm Technologies offer multiple reference and development boards which can be utilized across different domains for industrial and IOT use cases

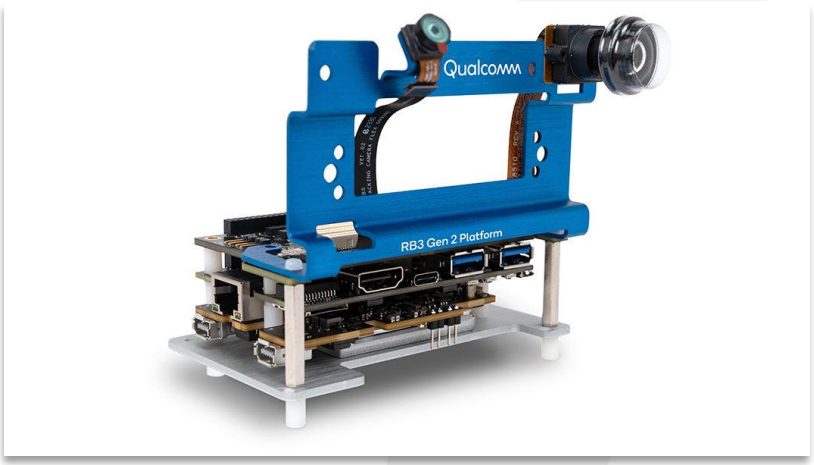
- Goal is to achieve SystemReady compliance for our UEFI based firmware releases for the Qualcomm® Linux ® platforms

Qualcomm® Platforms

- Qualcomm Dragonwing™ RB3Gen2 is the first board in the series of Qualcomm ® IOT platforms for SystemReady compliance
  https://www.qualcomm.com/developer/hardware/rb3-gen-2-development-kit



Core kit



Vision kit

ACS Test

- Successfully able to test capsule update

- SCT tests are passing for majority of the cases
  We are working on the few failure cases

- FWTS test cases are passing for all the mandatory UEFI services

Bootup with ACS

- BSA kernel module scans all the SCSI host devices and considers them as ATA host device
  “SystemReady DeviceTree” band devices may not support ATA
- Update required in BSA driver to handle such devices

```
[    8.677799] Unable to handle kernel paging request at virtual address ffff8000813db9c0
[    8.685950] Mem abort info:
[    8.688825]   ESR = 0x0000000096000007
[    8.692685]   EC = 0x25: DABT (current EL), IL = 32 bits
[    8.698154]   SET = 0, FnV = 0
[    8.701301]   EA = 0, S1PTW = 0
[    8.704538]   FSC = 0x07: level 3 translation fault
<snip>
[    8.824146] Hardware name: Qualcomm Technologies, Inc. Robotics RB3gen2 (DT)
[    8.831383] Workqueue: async async_run_entry_fn
[    8.836038] pstate: 20400005 (nzCv daif +PAN -UAO -TCO -DIT -SSBS BTYPE=--)
[    8.843187] pc : bsa_is_domain_monitored+0x70/0x118
[    8.848201] lr : bsa_is_domain_monitored+0x60/0x118
```

DT kselftest failure

- Failures are observed in dt_kselftest as certain remoteproc sub-devices are not getting probed as the ACS images don’t contain Qualcomm Technologies' FW images
- Working to check if the tests can be re-run after FW loading

/soc@0/remoteproc@3000000/glink-edge/fastrpc	**FAILED**
/soc@0/remoteproc@3000000/glink-edge/fastrpc/compute-cb@1	**FAILED**
/soc@0/remoteproc@3000000/glink-edge/fastrpc/compute-cb@2	**FAILED**
/soc@0/remoteproc@3000000/glink-edge/fastrpc/compute-cb@3	**FAILED**

DT validate failure

- UEFI firmware maintains a copy of upstream DTB which is loaded by default in the absence of a flashed DTB, and it is updated at every major release

- The dt_validate test was failing for board and soc compatible strings
- The issue was resolved after moving to kernel version used for DT schema validation to v6.7

/home/root/fdt/fdt: /: failed to match any schema with compatible: ['qcom,qcs6490-rb3gen2', 'qcom,qcm6490']	**FAILED**
/home/root/fdt/fdt: /: failed to match any schema with compatible: ['qcom,qcs6490-rb3gen2', 'qcom,qcm6490']	**FAILED**

DT validate failure

- The dt_validate test was failing for firmware supplied nodes for exporting DDR information to kernel and userspace clients as the properties are not documented as part of DT schema

/home/root/fdt/fdt: /: memory@80000000: 'ddr_device_channel', 'ddr_device_rank_ch0', 'ddr_device_rank_ch1', 'ddr_device_type' do not match any of the regexes: 'pinctrl-[0-9]+'	FAILED

- Previously efforts have been made to add these properties in DT schema [1] [2]
- Working towards alternate approach to read the information via SMEM [3]

[1] https://github.com/devicetree-org/dt-schema/pull/121

[2] https://github.com/devicetree-org/devicetree-specification/issues/62

[3] https://lore.kernel.org/all/20250410-topic-smem_dramc-v2-0-dead15264714@oss.qualcomm.com/

Distro selection and common challenges

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- SystemReady Devicetree band requires boot to shell on at-least three distributions from different groups - Fedora, OpenSUSE and Ubuntu distributions were selected

  - Drivers such QNOC, UFS were not available and were causing bootup failures
  - Each distro has its way of maintaining the kernel tree and config
  - Wait for the distro release with the required changes

Fedora	OpenSUSE	Ubuntu/Debian
Added “ignore_unused, pd_ignore_unused” in commandline from grub.conf	https://bugzilla.opensuse.org/show_bug.cgi?id=1231167 https://github.com/openSUSE/installation-images/pull/738	https://github.com/ricardosalveti/debian-linux/commit/76550d80a26cf8ba812bf4937e62cda09eb43cb5 https://salsa.debian.org/kernel-team/linux/-/merge_requests/1226 https://bugs.launchpad.net/ubuntu/+source/linux/+bug/2083559 https://bugs.launchpad.net/ubuntu/+source/linux/+bug/2106681

Distro Bringup

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OpenSUSE

```
Welcome to openSUSE Tumbleweed 20240827 - Kernel 6.11.0-rc3-default+ (ttyMSM0).


localhost login: root
Password:



Have a lot of fun...

localhost:~ #
localhost:~ #
```

Shell on OpenSUSE Tumbleweed KDE environment

```
localhost:~ # ls /dev/mmc*
/dev/mmcblk2  /dev/mmcblk2p1  /dev/mmcblk2p2  /dev/mmcblk2p3
localhost:~ #
localhost:~ # ls /dev/sd*
/dev/sda   /dev/sdc2   /dev/sde16  /dev/sde28  /dev/sde4   /dev/sde51
/dev/sda1  /dev/sdd    /dev/sde17  /dev/sde29  /dev/sde40  /dev/sde6
/dev/sda2  /dev/sdd1   /dev/sde18  /dev/sde3   /dev/sde41  /dev/sde7
/dev/sda3  /dev/sdd2   /dev/sde19  /dev/sde30  /dev/sde42  /dev/sde8
/dev/sda4  /dev/sdd3   /dev/sde2   /dev/sde31  /dev/sde43  /dev/sde9
/dev/sda5  /dev/sde    /dev/sde20  /dev/sde32  /dev/sde44  /dev/sdf
/dev/sda6  /dev/sde1   /dev/sde21  /dev/sde33  /dev/sde45  /dev/sdf1
/dev/sda7  /dev/sde10  /dev/sde22  /dev/sde34  /dev/sde46  /dev/sdf2
/dev/sdb   /dev/sde11  /dev/sde23  /dev/sde35  /dev/sde47  /dev/sdf3
/dev/sdb1  /dev/sde12  /dev/sde24  /dev/sde36  /dev/sde48  /dev/sdf4
/dev/sdb2  /dev/sde13  /dev/sde25  /dev/sde37  /dev/sde49  /dev/sdf5
/dev/sdc   /dev/sde14  /dev/sde26  /dev/sde38  /dev/sde5   /dev/sdg
/dev/sdc1  /dev/sde15  /dev/sde27  /dev/sde39  /dev/sde50  /dev/sdh
```

SD card and UFS devices in OpenSUSE Tumbleweed KDE environment

Fedora

```
Fedora Linux 42 (Server Edition Prerelease)
Kernel 6.12.0-0.rc0.20240920gitbaeb9a7d8b60.7.fc42.aarch64 on an aarch64 (ttyMSM0)

Web console: https://localhost:9090/

localhost login: root
Password:
[root@localhost ~]# ls /
afs  boot  etc   lib    media  opt   root  sbin  sys  usr
bin  dev   home  lib64  mnt    proc  run   srv   tmp  var
```

Shell on Fedora Rawhide environment

```
[root@localhost ~]# ls /dev/mmcblk2
mmcblk2     mmcblk2p1  mmcblk2p2  mmcblk2p3
[root@localhost ~]# ls /dev/sd
sda   sdb   sdd2  sde14  sde21  sde29  sde36  sde43  sde50  sdf1
sda1  sdb1  sdd3  sde15  sde22  sde3   sde37  sde44  sde51  sdf2
sda2  sdb2  sde   sde16  sde23  sde30  sde38  sde45  sde52  sdf3
sda3  sdc   sde1  sde17  sde24  sde31  sde39  sde46  sde6   sdf4
sda4  sdc1  sde10  sde18  sde25  sde32  sde4   sde47  sde7   sdf5
sda5  sdc2  sde11  sde19  sde26  sde33  sde40  sde48  sde8   sdg
sda6  sdd   sde12  sde2   sde27  sde34  sde41  sde49  sde9   sdh
sda7  sdd1  sde13  sde20  sde28  sde35  sde42  sde5   sdf
[root@localhost ~]# ls /dev/sd
sda   sdb   sdd2  sde14  sde21  sde29  sde36  sde43  sde50  sdf1
sda1  sdb1  sdd3  sde15  sde22  sde3   sde37  sde44  sde51  sdf2
sda2  sdb2  sde   sde16  sde23  sde30  sde38  sde45  sde52  sdf3
sda3  sdc   sde1  sde17  sde24  sde31  sde39  sde46  sde6   sdf4
sda4  sdc1  sde10  sde18  sde25  sde32  sde4   sde47  sde7   sdf5
sda5  sdc2  sde11  sde19  sde26  sde33  sde40  sde48  sde8   sdg
sda6  sdd   sde12  sde2   sde27  sde34  sde41  sde49  sde9   sdh
sda7  sdd1  sde13  sde20  sde28  sde35  sde42  sde5   sdf
```

SD card and UFS devices in Fedora Rawhide environment

Ubuntu

```
Ubuntu Oracular Oriole (development branch) ubuntu ttyMSM0

ubuntu login: ubuntu
Password:

Welcome to Ubuntu Oracular Oriole (development branch) (GNU/Linux 6.11.0+ aarch64)

 * Documentation:  https://help.ubuntu.com
 * Management:     https://landscape.canonical.com
 * Support:        https://ubuntu.com/pro

 System information as of Thu Sep 19 02:24:20 UTC 2024
```

Shell on Ubuntu Oracular with custom config

```
ubuntu@ubuntu:~$
ubuntu@ubuntu:~$ ls /dev/sd*
/dev/sda   /dev/sdc2   /dev/sde16  /dev/sde28  /dev/sde4   /dev/sde51
/dev/sda1  /dev/sdd    /dev/sde17  /dev/sde29  /dev/sde40  /dev/sde6
/dev/sda2  /dev/sdd1   /dev/sde18  /dev/sde3   /dev/sde41  /dev/sde7
/dev/sda3  /dev/sdd2   /dev/sde19  /dev/sde30  /dev/sde42  /dev/sde8
/dev/sda4  /dev/sdd3   /dev/sde2   /dev/sde31  /dev/sde43  /dev/sde9
/dev/sda5  /dev/sde    /dev/sde20  /dev/sde32  /dev/sde44  /dev/sdf
/dev/sda6  /dev/sde1   /dev/sde21  /dev/sde33  /dev/sde45  /dev/sdf1
/dev/sda7  /dev/sde10  /dev/sde22  /dev/sde34  /dev/sde46  /dev/sdf2
/dev/sdb   /dev/sde11  /dev/sde23  /dev/sde35  /dev/sde47  /dev/sdf3
/dev/sdb1  /dev/sde12  /dev/sde24  /dev/sde36  /dev/sde48  /dev/sdf4
/dev/sdb2  /dev/sde13  /dev/sde25  /dev/sde37  /dev/sde49  /dev/sdf5
/dev/sdc   /dev/sde14  /dev/sde26  /dev/sde38  /dev/sde5   /dev/sdg
/dev/sdc1  /dev/sde15  /dev/sde27  /dev/sde39  /dev/sde50  /dev/sdh
ubuntu@ubuntu:~$
```

SD card and UFS devices in Ubuntu Oracular with custom config

What’s next

- Get Dragonwing RB3gen2 platform 100% SystemReady Devicetree compliant
- Achieve SystemReady compliance for all Qualcomm Linux platforms

Thank You!