Who's Ahead of the Rest in the High-end ARM® Module Market

By Wolfgang Heinz-Fischer, Marketing Director/PR, TQ-Group

ARM generated a lot of favorable press by releasing the Cortex™-A8 and Cortex-A9 processors. Thanks to the efficiency of the processors, which are now virtually on a par with low power architecture processors, while simultaneously displaying a significantly smaller chip area and much lower power consumption, the ARM® processors are suitable for a number of applications in which x86 processors previously held the monopoly. Hardly a day goes by without a new alternative to x86 solutions being presented. Apart from solutions for Mini ITX and all SBC formats, various Embedded Module solutions are now also in the race. It is no wonder that leading x86 module providers are once again setting the tone here, although the providers which once led the ARM module sector are also bringing out interesting module solutions.

Compared to the ARM processors ARM9™ and ARM11™, in which the functions of the various chip providers were highly application-specific and thus very different in terms of signals, the high-end ARM processor functions are becoming increasingly similar to a PC chip, and the differences between the individual providers are in turn growing smaller. While a standard was out of the question for ARM9 and ARM11 processors, initial proposals for standardization are thus emerging for the Cortex processors. Motivation levels among providers varies greatly, and the market will show who will be successful in future. As can be seen on the x86 module market, it is, of course, also conceivable for various solutions to successful co-exist alongside each other.

Some features immediately become apparent when comparing the two standard solutions Q7 and the Ultra-Low-Power Computer-on-Modules (ULP-COM), initiated by Kontron with a proprietary solution. Apart from the purely objective points, users naturally also highly regard any special arguments raised by the providers in favor of their solution. The facts include size, plug system and the signals provided in the solution. In terms of module size, Q7, at 70 mm x 70 mm (4,900 mm²) is ahead of ULP-COM, which measures 82 mm x 50 mm (4,100 mm²). As can only be expected, proprietary solutions such as the Cortex-A8 TQ module TQMa53 measuring 56 mm x 44 mm (2,464 mm²) can be developed in a manner optimized for the board size. In reality, the actual space requirements on the carrier board should, of course, also be taken into account. The solutions using DIMM or MXM plugs also include the plug's surface area. This therefore results in a total area requirement of 5,110 mm² for a Q7 solution, and 4,480 mm² for the ULP-COM solution. The space requirement for the proprietary solution is identical to the board size, i.e. 2,464 mm² for a TQMa53. A smaller size is generally always better for users, since space ultimately costs money.

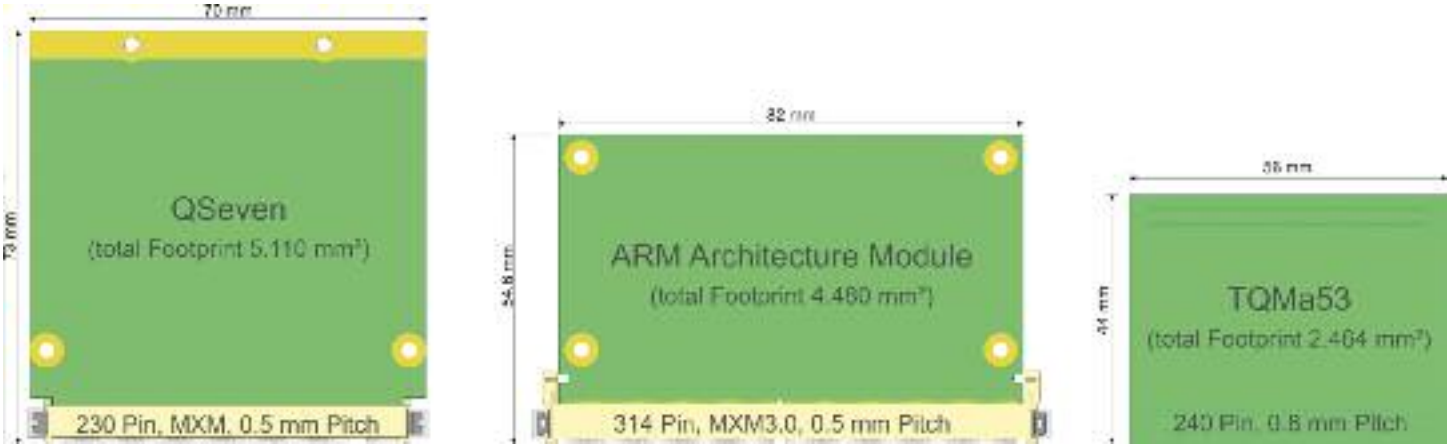

Figure 1: Q7-KARMA-TQMa53 comparison

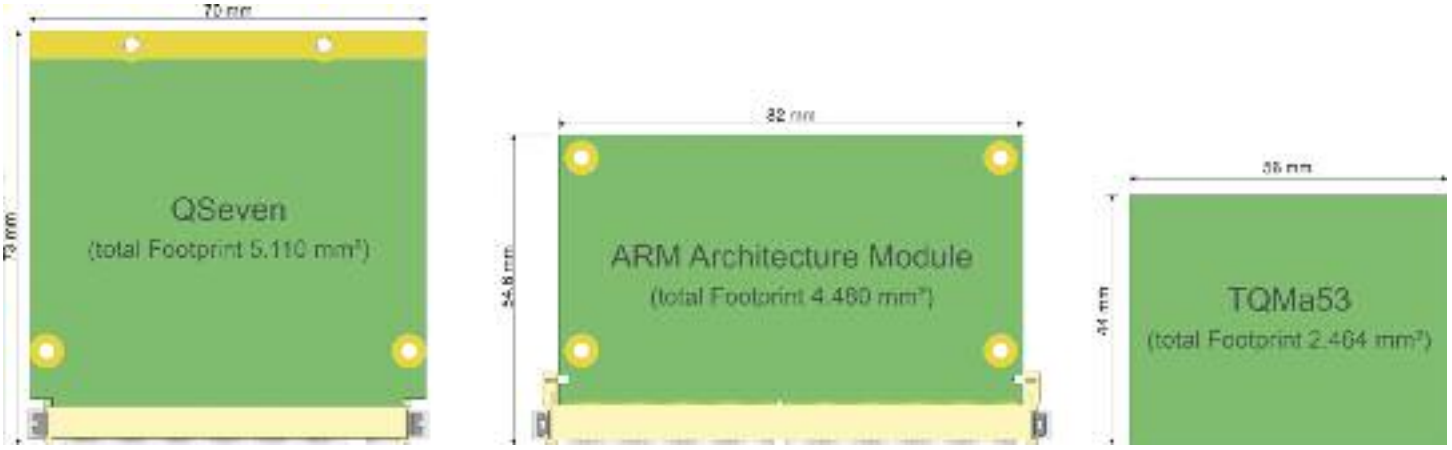

Figure 2: Q7-KARMA-TQMa53 comparison with plugs

The plug system establishes the number of possible signals on the one hand, but is also crucial for the area of application. In Q7, the MXM plug system is used with 230 pins and a 0.5 mm pitch, while the ULP-COM uses the MXM3.0 system with 314 pins and 0.5 mm pitch. Expert opinions as to whether or not these systems are suitable for use in harsh industrial environments vary greatly. The Tyco plug system employed in the TQMa53 with 240 pins and a pitch of 0.8 mm has been in use for more than 15 years, and has proven its industrial suitability in a number of challenging applications. All manufacturing companies are also proficient in using the 0.8 mm pitch.

The systems take completely different paths when it comes to plug arrangement and establishing functions. The Q7 system strives for compatibility with the existing x86 Q7 solutions, thereby essentially defining the PC interfaces. It is thus not the special Cortex-A8 and Cortex-A9 functions which are addressed here; the Q7 module instead utilizes the significantly lower power consumption of an appropriate ARM Cortex-A8 or Cortex-A9 Q7 module compared to a corresponding x86 Q7 module with similar performance and function. Of the total 230 pins, 177 are available for signals; the remaining 53 are required for the power supply and ground. Depending on the processor used, however, not all functions defined in the standard are implemented. The maximum available functions defined in the standard include four PCI Express Lanes, 1x Gigabit Ethernet, 8 USB ports, 1x CAN Bus, 1x I^2C, 1x SPI, 1x LPC Bus, 2x SATAs, 1x 8-bit SDIO, 2x Express Cards, HDA/AC'97, Dual Channel LVDS 24-bit, Display Port and various power and module management pins. A Q7 module, equipped, for example, with a Freescale Cortex-A8 i.MX53 processor, only provides approximately 100 signals; the remaining approximately 170 signals are not available in the application. On the other hand, the four PCI Express Lanes, LPC Bus, Express Card, Display Port and SM Bus are not used, and only 2x USB and a SATA implemented. The Gigabit Ethernet interface is only designed as a Fast Ethernet. So it is always crucial to know when each ARM processor is suitable for a Q7 module.

The ULP-COM system adopts a different approach. Its definition focuses more intensively on the specific functions of the ARM processors, and does not strive for direct compatibility with a corresponding x86 module, such as the COM Express. Depending on the application's requirement, a ULP-COM or COM Express module are thus used here. COM Express is only effective when many USB interfaces and a series of PCI Express Lanes are required. If a wide variety of displays, serial interfaces and, for example, a camera interface are necessary, the ARM solution is the better approach. The ULP-COM system tries to establish as large as possible a common denominator as a standard for the high-end ARM processors of various manufacturers. As is once again the case here, depending on the processor used, not all functions are implemented. Of the 314 pins, 257 are signal pints and 57 supply pins. The maximum functions include three

Product	Q7 Spec		ULP Spec		TQMa53		i.MX53	
Functiongroup	Function	No. of Pins	Function	No. of Pins	Function	No. of Pins	Function	No. of Pins
PCI Express Lanes	4 Lanes	20	3 Lanes	27	N/A	0	N/A	0
Ethernet 10/100 Mbit/Gigabit	1x Gigabit Ethernet	13	1x Gigabit Ethernet	13	1x Fast Ethernet	12	1x Fast Ethernet	12
USB 2.0 ports	8x	22	3x	11	2x	8	2x	8
Serial	N/A	0	4x	12	3x	8	3x	8
CAN Bus	1x	2	2x	4	2x	4	2x	4
I²C	1x	2	5x	10	3x	6	3x	6
SPI	1x	5	2x	9	2x	13	2x	13
LPC Bus	1x	8	N/A	0	N/A	0	N/A	0
SATA	2x	9	1x	5	1x	7	1x	7
SDIO	1x 8 bit	14	1x 4 bit	9	1x 4 bit	8	1x 4 bit	8
ExpressCard	2x	4	N/A	0	N/A	0	N/A	0
eMMC	N/A	0	1x 8 bit	11	N/A	0	1x 8 bit	10
I2S / HDA	HDA / AC'97	5	I2S / HDA	16	HDA	5	HDA	5
LVDS	Dual Channel 24 bit	27	Single Channel 18/24 bit	14	Dual Channel 18/24 bit	24	Dual Channel 18/24 bit	24
Parallel LCD	N/A	0	1x 24 bit / RGB	28	1x 24 bit / RGB	28	2x 24 bit / RGB	56
DisplayPort, HDMI, SDVO	DisplayPort, TMDS, SDVO	18	HDMI, secondary Display	12	N/A	0	N/A	0
VGA	N/A	0	N/A	0	1x	5	1x	5
SPDIF	N/A	0	1x	2	1x	2	1x	2
Camera 0	N/A	0	Camera 0	7	N/A	0	N/A	0
Camera 1	N/A	0	Camera 1 / parallel 10 bit	14	Camera 1 / parallel 16 bit	23	Camera 1 / parallel 16 bit	23
GPIO	N/A	0	GPIO	12	GPIO	13	GPIO	31
SM Bus	SM	3	N/A	0	N/A	0	N/A	0
Miscellaneous / Reserved	Miscellaneous / Reserved	25	Miscellaneous / Reserved	41	Miscellaneous / Reserved	15	Miscellaneous / Reserved	47
Total Signal Pins		177		257		181		269
VCC		23		11		7		
GND		30		46		52		
Total Pins		230		314		240		

Figure 3: Pin comparison

PCI Express Lanes, 1x Gigabit Ethernet, 3 USB ports, 4x serials, 2x CAN Buses, 5x I²Cs, 2x SPIs, 1x SATA, 1x 4-bit SDIO, 1x 8-bit eMMC, I2S/HDA, Single Channel LVDS 18/24-bit, 24-bit Parallel LCD, HDMI, 1x SPDIF, 2x camera interfaces, GPIO and various power and module management pins. Depending on assembly, some signals defined in the standard are once again not supported by the processor, and not all processor signals are available on the plug. When comparing the system with a Q7, and also an assembly with a Freescale Cortex-A8 i.MX53 processor, approx. 170 signals of the processor's approx. 270 signal pins are provided on the ULP-COM plug. The three PCI Express Lanes, HDMI graphics, only two of three possible USB ports, three of four possible serial interfaces and three of five possible I²C interfaces are not supported.

Figure 4: Cortex-A8 module TQMa53

A proprietary system, such as the TQ Cortex-A8 module TQMa53, can, of course display the processor in optimum fashion. The module ideally has a compact size and provides all processor signals on the plug. Unlike standardizations, the module does not have any pins which are not used by the processor. The TQMa53 is optimized in terms of cost, and thus makes compromises when it comes to available signals. The robust plug system with 240 pins provides approximately 180 signals out of the processor's total approx. 270 signals. The eMMC interface, used internally on the module, the second parallel LCD and some GPIOs are not supported. Out of all the proprietary modules offered with i.MX53, the TQMa53 does, however, provide the most pins on the plug. An optimum proprietary module for the Freescale Cortex-A8 processor, which provides all signals, would require approximately 320 pins, which would entail a board space of approximately 56 mm x 50 mm.

The issue of which system is right for the user is a completely personal decision. If size plays a major role and the functions of the specific processor are important, the proprietary systems have an advantage. If the shock and vibration requirements are crucial, the plug system used plays an important role. If a Q7 or COM Express module has previously been used and the new system is purely designed to use less power, a Q7 or ULP-COM may be the right choice. In any case, the user must be well aware that it is not possible to directly interchange existing x86 solutions and ARM solutions without relevant adjustments. And that, in the event of a changeover, the application board is generally also optimized and revised. It is therefore not absolutely crucial to have mechanical compatibility. In any case, the embedded module market is heating up.

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