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Standalone transceiver chips to dominate the smartphone market, says Petrov Group (part 1)

By LJ Ristic, Managing Director, Mobile Devices, at the Petrov Group -- Friday 21 October 2011

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Transceivers are essential to the performance of mobile devices. They are designed to detect weak signals at a specific frequency when receiving and to send signals at a specific frequency when transmitting. The particular frequency used depends on a working mode.

This is part 1 of a series. Part 2 will be published next week.

With the advancement and proliferation of communications standards the complexity of transceivers has grown to meet the requirements for backwards compatibility with the existing network infrastructure. Thus, an LTE capable mobile device needs to work in LTE mode on corresponding LTE frequency bands but also on different frequency bands in 3G and 2G modes. This is very demanding on transceivers since they need to work reliably on every single band, from 4G down to 2G.

It should be pointed out that the LTE standard is finally becoming a dominant WWAN 4G technology despite the fact that WiMAX has had the advantage of being the first-comer and a head start of a few years to establish itself, said Lj Ristic, managing director at the Petrov Group. But WiMAX never had the backing of the big carriers and in the end it is destined to become a marginal technology.

Even Clearwire, the major driver of WiMAX, is currently adopting LTE technology. Many other prominent WiMAX players have done the same including Altair Semiconductor, Sequans, Beceem Communications (acquired by Broadcom), and GCT Semiconductor. LTE is taking shape in two forms – FDD-LTE and TDD-LTE – and it appears that there are different preferences among regions. Europe and the USA are marching forward with FDD LTE, while China, India, possibly Japan, and the rest of Asia are partnering to push TDD-LTE. A WiMAX migration path to LTE is available via TDD-LTE.

The complexity of transceivers has a direct impact in shaping strategic decisions for these products. A closer analysis points to two important distinctions among transceivers. For low-end phones that are based on the EDGE/GPRS/GSM standards there is a clear benefit of integrating the transceiver with the baseband together on the same chip. This is possible since the complexity of transceivers for 2G is much lower. Integration reduces the cost and time to market and both are critical for low-end phones.

However, for smartphones that are based on 3G and 4G standards the strategy is different – the transceivers are designed as standalone (S/A) chips (i.e. a transceiver not integrated with baseband). Transceivers for 4G/3G are more complex, they use higher order modulation, work on multiple bands, include a diversity option, are mixed-signal in nature, and all together designers deal with a completely different set of challenges compared to basebands. Thus, an integration strategy does not make sense anymore. The Petrov Group believes that S/A transceiver chips will dominate the smartphone and tablet market in years to come, commented Ristic.

It appears that all major transceiver companies are adopting the S/A approach for 4G/3G transceivers although all of them have baseband products in their product portfolio and the means to integrate the two.

The RF transceivers industry has gone through significant consolidation in the last decade and many of the innovative smaller RF companies have been acquired by the big players. Qualcomm has acquired Berkana, Intel has acquired Infineon Wireless business, ST Microelectronics and Ericsson have joined forces together, and Fujitsu Microelectronics has acquired RFIC technology from Freescale. Also, MediaTek has acquired technology from Analog Devices, while Spreadtrum has acquired Quorum

Systems. The same goes for Nvidia which got Sirific's RF technology through its acquisition of Icera. Broadcom has acquired Athena Semiconductor and Beceem, while Renesas Mobile has acquired a wireless modem team and technology from Nokia and also joined forces with NEC.

Practically all big transceiver players have acquired a company or technology, and all of them offer complete chipset solutions for smartphones and tablets. In other words, besides transceivers they also offer basebands and application processors. As a consequence, today's RF transceiver market is dominated by large vendors offering a full range of critical handset ICs, summarized Ristic.

Looking at the list of transceiver products from the leading suppliers one can see that CMOS technology has indeed become the mainstream technology for transceivers. The transition of transceiver products from BiCMOS technology to CMOS is practically complete although there are still some legacy products in older BiCMOS nodes on the last leg of their lifecycle.

Qualcomm has the strongest transceiver product portfolio. Qualcomm currently offers transceivers with different additional connectivity features such as GPS, Bluetooth, and FM radio. However, in the next generation of transceivers, the WTR series, it looks like Qualcomm will adopt the same combo strategy for connectivity that Broadcom has pioneered and offer only S/A transceivers or S/A transceivers with GPS.

Intel, Fujitsu, ST Ericsson, and Broadcom, all offer S/A transceivers and have good traction with customers, while MediaTek and Spreadtrum have strong positions in China but still need to develop LTE solutions. Nvidia should get traction in the near future since it is now able to offer full chipset solutions.

Renesas offers the only LTE solution that fully integrates transceiver and baseband on a single chip (this was actually developed by Nokia) but it remains to be seen how much traction this solution will have since Renesas also goes in the opposite direction with the integration of baseband and application processor on the same chip (which makes more sense).

GCT Semiconductor has leveraged its expertise in WiMAX and designed a single chip LTE transceiver and baseband that serves only LTE applications (LG Electronics, Verizon, AT&T, and Vodafone have adopted this solution) but it can also be used as a complement to 3G/2G solutions. It is interesting to mention that GCT Semi's CDMA transceivers paired with Via Telecom CDMA baseband offers an alternative to Qualcomm's CDMA chipset solutions. Samsung has already adopted this alternative for some of its products.

It is important to note that today leading edge transceiver products are at the 65nm node, said Ristic. This means transceivers are at least two generations behind the processors. We expect the lagging trend to continue. When transceivers migrate down to the 45/40nm and 32/28nm nodes they will still be behind processors by one to two generations. Some have already announced migration of future transceiver products to the 28nm node.

The lifecycle of transceivers is longer than the lifecycle of processors, especially application processors. This is why we still see transceivers in use that were designed in the 130nm and 110nm CMOS nodes. One of the reasons for the transceiver's longer life time is the product certification process.

As is the case with basebands, transceivers need to be certified before they are approved for use. Because of their complexity the certification process is lengthy and involves comprehensive testing. Approval means they can be used in mobile devices such as smartphones, tablets, and dongles. The complexity of the certification process also implies that manufacturers of mobile devices want to avoid repeating this process as long as they can. Using already approved transceivers again and again reduces the risks associated with a new product introduction for handset manufacturers. It is not unusual to see transceiver products in two generations of mobile devices, sometimes even three.

Modern semiconductor technology offers more than one option for integration. Often when it is not optimal to integrate at the silicon level it can be done in a different form – with advanced packaging. Packaging technology has made tremendous progress in the last decade, and advanced multi-chip

packaging has already become a reality; today it is common to see products with package-on-package, package-in-package, or with through-mold vias technology, all in an attempt to get a compact form factor. Thus, one could also expect to see some transceiver chips combined in a package with other chips achieving performance and form factor optimized for a particular mobile device, concluded Ristic.

Petrov Group: Most common frequency bands used in WWAN

Standard	Common Frequency Bands	Backwards Compatible	XCVR Integration with BB	XCVR with Diversity Option
4G				
LTE (FDD)	700/800	HSPA+/EDGE/GPRS/ GSM	S/A	Yes
LTE (TDD)	1900/2300/2600	HSPA+/EDGE/GPRS/ GSM	S/A	Yes
WiMAX	2300/2500/3500		Yes (w WiMAX BB)	Yes
3G- GSM				
HSPA+/HSPA	850/900/1900/2100	EDGE/GPRS/GSM	S/A	Yes
WCDMA	850/900/1900/2100	EDGE/GPRS/GSM	S/A	
TD-SCDMA	1900/2000	EDGE/GPRS/GSM	S/A	
3G-CDMA				
CDMA 2000 EVDO	800/1900	CDMA 1xRTT	S/A	Yes
2G				
eEDGE/EDGE	850/900/1800/1900	GPRS/GSM	Yes	
GPRS/GSM	850/900/1800/1900		Yes	

Source: Petrov Group, compiled by Digitimes, October 2011

Petrov Group: Leading xCVR Companies						
	xCVR Product	xCVR Product	xCVR Product	xCVR Product	xCVR Product	Matching Baseband
	2G/2.5G	3G/2G	LTE/3G/2.5G/2G	LTE Only	CDMA	
Qualcomm		x	x		x	Qualcomm
Intel	x	x	x			Intel
ST Ericsson	x	x	x			ST Ericsson
Fujitsu Microelctronics		x	x			Partners
MediaTek	x	x				MediaTek
Spreadtrum	x	x				Spreadtrum
Nvidia		x	x			Nvidia
Renesas Mobile	x	x	x*			Renesas, Marvell
BRCM	x	x				BRCM
GCT Semi	x	x		x **	x	Via Telecom

** Note: Renesas has fully integrated single chip BB+xCVR that covers LTE/3G/2G standards*
*** Note: GCT Semi has integrated only LTE solution (single chip BB+xCVR)*
Source: Petrov Group, compiled by Digitimes, October 2011

Petrov Group: Transceiver Products				
Company	Product Examples	WWAN Standard	Node	Comments
Qualcom	RTR8600	LTE/HSPA+/EDGE/GPS	65nm CMOS	S/A, RxD
	QRT8600L	LTE/HSPA/EDGE/BT/FM	65nm CMOS	S/A, RxD
	QRT8600	WCDMA/CDMA2K/EDGE/BT/FM/GPS	65nm CMOS	S/A, RxD

	WTR1605L	LTE/HSPA+/CDMA2K/TD-SCDMA/EDGE/GPS	65nm CMOS	S/A, RxD
	WTR1605	HSPA+/CDMA2K/TD-SCDMA/EDGE/GPS	65nm CMOS	S/A, RxD
	QTR8200	WCDMA/EDGE/GPS/BT/FM	65nm CMOS	S/A
	RTR6285	WCDMA/EDGE/GPS	180nm CMOS	S/A
Intel	Smarti LU	LTE/3G/2G	65nm CMOS	S/A, RxD
	Smarti UE2	HSPA+/EDGE/GSM	65nm CMOS	S/A, RxD
	Smarti UE+	HSPA/EDGE/GSM	130nm CMOS	S/A, RxD
	Smarti UE	WCDMA/EDGE/GSM	130nm CMOS	S/A
ST Ericsson	RF7400	LTE/HSPA+/EDGE	65nm CMOS	S/A, RxD
	Aero4229	HSPA/EDGE	110nm CMOS	S/A
	Aero4228, DigRF	HSPA/EDGE	110nm CMOS	S/A
	Aero 4260	TD-SCDMA	130nm CMOS	S/A
	Aero4223	EDGE/GPRS/GSM	110nm CMOS	S/A
	Aero 4213, DigRF	EDGE/GPRS/GSM	110nm CMOS	S/A
Fujitsu Microelectronics	MB86L12A	LTE/3G/2G	90nm CMOS	S/A, RxD
	MB86L10A	LTE/3G/2G	90nm CMOS	S/A, RxD
	MB86L01A	3G/2G	90nm CMOS	S/A
MediaTek	MT6140	EDGE/GPRS/GSM	0.35-micron	S/A

			BiCMOS	
	AD6547	TD-SCDMA	0.35-micron BiCMOS	S/A
Spreadtrum	SR3100	HSPA/WCDMA/EDGE		S/A
	QS520	GPRS/GSM	130nm CMOS	S/A
	QS1001	EDGE	130nm CMOS	S/A
	QS3200	TD-SCDMA/HSPA/EGE	130nm CMOS	S/A
Nvidia	ICE8261	LTE/3G/2G	130nm CMOS	S/A, RxD
	ICE8260	HSPA/WCDMA/EDGE	130nm CMOS	S/A, RxD
	ICE9225	HSPA+/3G/2G	65nm CMOS	S/A, RxD
Renesas Mobile	SP2531	LTE/HSPA+/2G *	65nm CMOS	Integrated, RxD
	R2A60281LG	HSPA/WCDMA/EDGE	0.18-micron BiCMOS	S/A
	R2A60177BG	EDGE/GPRS/GSM	0.18-micron BiCMOS	S/A
Broadcom	BCM2091	HSPA/EDGE	65nm CMOS	S/A
	BCM2085	EDGE/GPRS/GSM	65nm CMOS	S/A
GCT Semi	GDM7240 *	LTE * (only LTE)	65nm CMOS	Integrated, RxD
	GRF6401	CDMA EVDO		S/A

** XCVR+BB intgrated on a single chip*
Source: Petrov Group, compiled by Digitimes, October 2011

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