Baseband processors still essential, says Petrov Group

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With the proliferation of tablets and smartphones application processors are in the limelight, but another group of mobile processors, basebands, deserve attention too, according Lj Ristic, managing director for mobility/wireless business at the Petrov Group. Baseband processors, often called phone modems, are essential to the performance of mobile devices – they make communications between devices possible and also provide additional support for some basic multimedia features. Without basebands the functioning of mobile devices would have been impossible.

With the advancement of communication technology and communications standards the complexity of baseband processors has grown in time.

The telecommunications industry has not done a good job when it comes to harmonization of standards. However, where standardization has failed the inventiveness of engineering has succeeded in designing baseband products capable of supporting all standards and multiple bands. But that has also led to the complexity of basebands since every next generation of products has to be backwards compatible and capable of supporting all legacy standards. For example a 3G mobile device needs to work on three 3G bands as well as on four EDGE/GPRS/GSM bands; or an LTE capable mobile device would work on LTE bands, 3G bands, and four 2G bands. Each time we adopt a new standard the complexity of baseband processor to support that standard goes up, said Petrov Group.

Because of their complexity and the need for reliable function there is a special certification process for baseband processors before they are approved for use. The process is lengthy and involves comprehensive testing. The approval of baseband means that it can be used in mobile devices such as smartphones and tablets. It also means that manufacturers of mobile devices want to use the same basebands as long as possible without changing them and going through another risky certification process. One of the consequences of this approach is that the life cycle of basebands is certainly longer than the life cycle of application processors, commented Ristic. Changing an application processor and keeping the same baseband will lead to new features and product differentiation with reduced risk to the phone or tablet manufacturer.

A closer look points to two crucial distinctions among baseband processors. For lower tier phones (also called basic phones, white-box phones, or feature phones) that mostly use the GPRS/GSM and EDGE standards there is a clear trend of integration of baseband together with transceiver and power management (and even FM radio) on the same chip. This reduces the cost and time to market, both being of paramount importance for low-end phones manufacturers. Basebands for low-end phones are also setting another trend; they offer multi-SIM features, crucial for design of dual-SIM (or multi-SIM) phones which are becoming very popular in India, China, Africa, Russia, Brazil, and other countries where there is a high use of low-end phones.

On the other side, high-end basebands targeting smartphones and tablets (which mostly use 3G and 4G standards because of the higher data rates needed to experience media-rich applications) are made as stand alone. They are digital in nature and more complex than basebands for 2G. At the same time transceivers for 3G and 4G are also more complex; they use higher order modulation for communications, and they are mixed-signal in nature. Integration of two complex chips with two different sets of challenges would exponentially increase the risk, thus keeping them separate makes logical and strategic sense, according to Petrov Group.

It should be pointed out that modern semiconductor technology offers more than one option for integration. What cannot be done (or is not smart to do) at the silicon level can be done with

packaging. Packaging technology has made tremendous progress in the last decade to the point that 3D packaging has become a reality. We are witnessing products with package on package, package in package, or through-mold vias technology, which enable a compact form factor for products combining processors and memories, or processors and transceiver, to mention a few. For example Qualcomm is well known for multichip solutions that include baseband, transceiver, and power management chip together in a single package. This integration approach allows for optimization and a different choice of silicon nodes for standalone chips.

It is also interesting to note that currently baseband products are clustered at the 65nm node. This is one generation behind standalone application processors or integrated mobile processors (processors that integrate baseband, application processor and GPU on a single chip) that are already at the 45/40nm node. We expect this lagging trend to continue. By the time basebands migrate down to the 40nm node, although LTE basebands are currently doing it, the other two will be already at the 32/28nm node. This is in line with the fact that the life cycle of baseband products is longer than the life cycle of application processors, noticed Ristic.

Baseband Processor Market

The baseband processor market is directly related to the mobile device market (which includes handsets and tablets).

The highest growth segment, tablets, is expected to reach more than 200 million units by 2015. The smartphone segment is the second highest growth segment to reach 1.2 billion units by 2015. The non-smartphone segment will stay at the level of 2010 in a number of units. Here two opposite trends cancel each other – the GPRS/GSM segment will decline while the EDGE segment continues to grow.

On the handset side, the low-end devices based on the GPRS/GSM standard dominated the market in 2010 with 57% of market share and almost 900 million units. This segment will significantly decline by 2015 down to 25% of market share, while all other segments will grow. The other three segments, EDGE, WCDMA, and CDMA 2000, were close to each other in 2010 with 15%, 11%, and 15%, respectively. By 2015 the 3G HSPA/WCDMA segment will become the biggest thanks to smartphone growth. The CDMA segment will also grow but its market share in 2015 will remain the same as in 2010, says Petrov Group.

For all practical purposes the LTE segment was nonexistent in 2010, although many trials have taken place worldwide laying a foundation for future use. LTE got an additional boost thanks to the Digital Dividend Initiative which made UHF frequency bands, 700MHz and 800MHz, available for use. This is important for the future of LTE since the cost of operation at these bands is much lower than at 2.6GHZ and also the propagation characteristics are much better in buildings (less attenuated). The LTE segment is expected to reach about 10% market share by 2015.

On the tablet side it is expected that among tablets featuring phone-connectivity the 3G HSPA/WCDMA segment will dominate the market with approximately a 2 :1 ratio compared to the CDMA 2000 segment. It is also expected that the predominant tablet segment will be tablets without phone-connectivity but with Wi-Fi/WiMAX connectivity.

Baseband processors are directly correlated to mobile devices. For each mobile device with phone-connectivity one baseband is needed. The total number of basebands reached 1.5 billion in 2010 and will reach more than 2.5 billion by 2015 (this is with the inclusion of integrated mobile processors). If integrated mobile processors are excluded the number of basebands will reach more than two billion by 2015, said Ristic.

The GPRS/GSM and EDGE market segments combined (GGE basebands) were represented in 2010 by 1.1 billion which was about 73%. These two segments combined will lose the market share by 2015 declining down to 43%. The GGE segment is becoming a commodity type of the product and the price-war that we saw in 2010 among MediaTek, Spreadtrum, and MStar will lead to a further decline of ASPs for these products.

On the other hand, the high-end baseband segment with 3G and 4G capability will be still able to command premium because of the complexity of these baseband processors. Multi-mode 3G/4G basebands reached about 400 million units in 2010 and they will pass the one billion mark by 2015, representing about 40% of market share, reaching the GGE baseband group in number of units and exceeding it significantly in dollar value. This will happen thanks to smartphone and tablet growth.

Integrated mobile processors represented only 30 million units or 2% of market share in 2010 – all of these being Snapdragon processors shipped by Qualcomm. Integrated mobile processors should reach about 16% of market share by 2015 and grow to about 400 million units in volume.

In summary, by 2015 the baseband processor market will be the biggest segment in units among mobile processors reaching 2.2 billion units while integrated mobile processors will reach 400 million units, concluded Petrov Group.

Petrov Group: WWAN telecommunications standards			
Standard	**Modulation**	**Common bands (MHz)**	**Max data rate**
2G			
GSM/GPRS	GMSK	850/900/1800/1900	9.6/144Kbps
EDGE/eEDGE	8PSK/16 QAM	850/900/1800/1900	384/ up to 1000Kbps
3G - GSM			
WCDMA	QPSK	850/900/2100	2.4Mbps
HSPA	16 QAM	850/900/2100	14Mbps
HSPA+	64QAM	850/900/2100	42Mbps
TD-SCDMA	QPSK/8PSK	2000	2Mbps
3G - CDMA 2000			
CDMA 2000 1XRTT	QPSK/OQPSK	800/1900	144Kbps
CDMA 2000 EVDO	QPSK/8PSK/16QAM	800/1900	2.4Mbps
4G			
LTE	64 QAM	700/800/2600	172Mbps/326Mbps
WiMAX (16e)	BPSK/QPSK/16QAM/64QAM	2300/2500/3500	75Mbps
WiMAX (16m)	BPSK/QPSK/16QAM/64QAM	2300/2500/3500	300Mbps and up

Source: Petrov Group, compiled by Digitimes, May 2011

Petrov Group: Baseband processors from key manufacturers					
Basebands	**Product**	**WWAN Ssandards**	**Single chip integration**	**Core**	**Node**
2G					
Intel	X-Gold 116	GSM/GPRS	BB+XCVR+PMU+FM Radio	ARM 11	65nm
MediaTek	MT6252	GSM/GPRS	BB+XCVR+PMU	ARM 7	65nm
Spreadtrum	SC6800D	GSM/GPRS	BB	ARM 9	65nm
ST-Ericsson	G4852	GSM/GPRS	BB+XCVR+PMU, Dual SIM	ARM 9	65nm
2.75G					
Intel	X-Gold 213	EDGE/GPRS/GSM	BB+XCVR+PMU+ FM Rad, Dual SIM	ARM 11	65nm
Broadcom	BCM21331	EDGE/GPRS/GSM	BB+XCVR+PMU+ FM Radio	ARM 9	65nm
MediaTek	MT 6236	EDGE/GPRS/GSM	BB+XCVR	ARM 9	65nm
ST-Ericsson	E4915	EDGE/GPRS/GSM	BB+XCVR+PMU	ARM 9	65nm
3G GSM					
Intel	X-Gold 616	HSPA/WCDMA/EDGE	BB+PMU	ARM 11	65nm
Broadcom	BCM 2153	HSPA/EDGE	BB	ARM 11	65nm
Spreadtrum	SC8800G	TD-SCDMA/GPRS/GSM	BB	ARM 9	40nm
QCOM	MSM7225/27	HSPA/EDGE/GPRS/GSM	BB	ARM 11	65nm
Marvell	PXA 930	HSPA/WCDMA/GPRS/GSM	BB	XScale	65nm
MediaTek	MT 6276	HSPA	BB, Dual SIM	ARM 11	65nm
ST-Ericsson	T6710/18	HSPA/WCDMA/EDGE	BB	ARM 9	65nm
3G CDMA 2000					
QCOM	MSM7625/27	CDMA/HSPA/EDGE	BB	ARM 11	65nm
4G		LTE			
Intel	X-Gold 706	LTE/3G/2G	BB+PMU		40nm
QCOM	MDM9200	LTE/3G/2G	BB		45nm

ST-Ericsson	Thor M720	LTE/HSPA+	BB		65nm
Renesas	SP2531	LTE/HSPA+	BB		45nm

Source: Petrov Group, compiled by Digitimes, May 2011

Petrov Group: Mobile device market segmentation by standard					
	2010	**2010**	**2015**	**2015**	
Mobile Devices	Units (m)	Market share (%)	Units (m)	Market share (%)	CAGR (%)
Non-smart phones	1200	79	1200	46	0
Smartphones	300	20	1200	46	32
Total Handsets	1500	99	2400	92	10
Tablets	18	1	220	8	65
Total Mobile Devices	1518	100	2620	100	12
	Units (m)	Market share (%)	Units (m)	Market share (%)	CAGR (%)
Mobile Handsets by Standard	1500		2400		
GSM/GPRS	870	57	650	25	(6)
EDGE/eEDGE	235	15	480	18	15
WCDMA/HSPA/TDSCDMA	170	11	670	26	32
CDMA 2000	225	15	360	14	10
LTE	0	0	240	9	
	Units (m)	Market share (%)	Units (m)	Market share (%)	CAGR (%)
Tablets by Standard	18	1	220	8	65
Tablets with WCDMA/HSPA/TD-SCDMA	11	1	70	3	46
Tablets with CDMA 2000	3	0	30	1	58
Tablets with LTE	0	0	10	0	
Tablets without WWLAN	4	0	110	4	94

Source: Petrov Group, compiled by Digitimes, May 2011

Petrov Group: Baseband processors market Summary					
	2010 units (m)	2010 market share (%)	2015 units (m)	2015 market share (%)	CAGR (%)
Total Basebands	1518		2620		
GGE Basebands	1105	73	1130	43	0
Multimode Basebands 3G/4G	383	25	1080	41	23
IM Processors 3G/4G	30	2	410	16	69

Note: GGE - GPRS/GSM and EDGE market segments combined
Source: Petrov Group, compiled by Digitimes, May 2011

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