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Icera Well Positioned in Slim Modems for Mobile Broadband

Snapshot

Qualcomm and ST-Ericsson are expected to become the leading suppliers of cellular chipsets for LTE mobile devices over the next few years. However, through its lead in "soft modems" and the progress it has already made with OEMs in W-CDMA / HSPA embedded data modems and USB dongles, it appears that **Icera will quickly emerge as the third most successful supplier of LTE basebands and chipsets**, well ahead of Infineon, MediaTek, Broadcom, the Japanese suppliers and a host of start-ups.

Analysis

Since the success of the Apple iPhone starting in 2007, an increase in consumer demand for data-rich applications has led to new mobile devices such as the Android, eBook readers, tablets, and netbooks. Mobile operators welcome the higher ARPU delivered by broadband services beyond voice and SMS, but to get this they need more than just customers willing to pay more for higher data rate plans. They also need the improved spectral efficiency and capacity available only through advanced air interfaces such as LTE.

Icera's Unique Solution: Software-Reconfigurable Basebands

The advantages of Icera's basebands have launched the company on a promising trajectory in mobile broadband. Icera claims that its slim modem baseband processors have a smaller footprint and equal or better performance compared to products from competitors Qualcomm and ST-Ericsson, and these advantages are apparently real, having received positive attention from **Nokia** and **Samsung:**

- At only 19 square millimeters, Icera's ICE8040 has a smaller footprint than slim modem basebands from Qualcomm and ST-E that also support HSPA+ / HSUPA (DL / UL), as shown in Exhibit 1;

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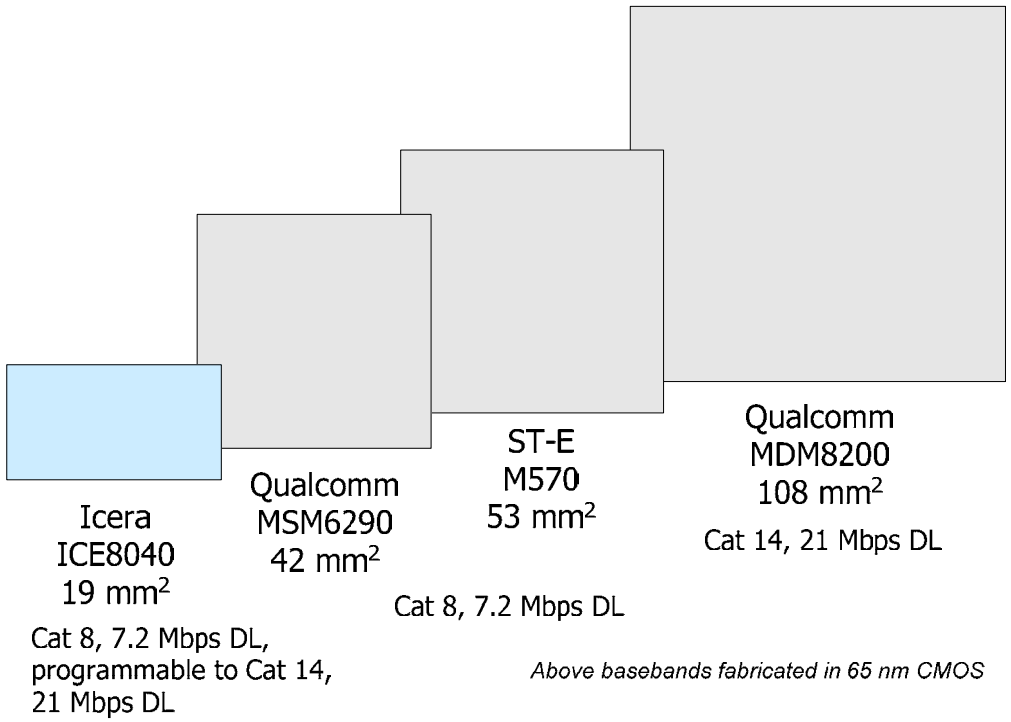
- Icera claims that the ICE8040 has half the power consumption of Qualcomm's MDM8200, although this depends on channel conditions and is probably 'best case' if strictly accurate;

- Note that by "slim modem" we mean a baseband that does not support applications, relying instead on a host processor for the graphical user interface and application OS.

Exhibit 1 Comparative Footprints of Leading Slim Modems for HSPA+ / HSUPA



Source: Icera

- Icera shipped approximately 3 to 4 million basebands in 2009, which they believe gave them between 5 percent and 10 percent share of a roughly 45 million unit market for PC data, embedded data and M2M modems. Qualcomm led with about 90 – 95 share of the market in 2009:

  - Nokia uses an Icera baseband in one of its HSPA dongles. Samsung uses the Icera ICE804x baseband (E3xx platform) in the N150 netbook to support HSPA+ (DL) at 21 Mbps;

  - An Icera baseband is also used in the QUE eReader from Plastic Logic, and in the Option Quicksilver HPSA USB dongle offered through AT&T Mobility in the US;

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- Given the flexibility of Icera's basebands and upcoming models for HSPA+ / HSUPA MIMO, dual cell (Rel 8) and LTE at 40 nm and 28 nm, the company appears to be well-positioned to at least double its market share to 15 percent in 2010 and beyond;

- In 2010, we expect the market for data and M2M modems to grow to more than 100 million units. In 2011, LTE mobile device shipments will reach 15 – 20 million units, most of these data cards, embedded modems and dongles.

Icera achieves efficient re-use of the transistors in its basebands to reduce power consumption and minimize the size and cost of the chip. This re-use consists of reconfigurability by software to support different air interfaces, and it also allows dynamic reconfigurability within the chosen air interface to keep power consumption down depending on channel conditions:

- Icera claims to have **the only successful software modem on the market**. Instead of consisting of hardware blocks dedicated to specific high-level processing functions, the hardware elements within the baseband can take on different tasks through software configurability as processing needs change. Icera uses dedicated hardware blocks only for relatively primitive architectural elements such as multipliers, adders and memory registers;

  - Icera uses what it calls DXP (Deep eXecution Processor) cores in addition to ample on-chip memory registers and some I/O bus interface logic. One [scalar] DXP handles the stack, codecs and encryption, while a second [vector] DXP with two channels typically handles additional PHY tasks such as RAKE receiver, antenna diversity, channel optimization, MIMO and MMSE equalization. Icera does not use ARM microprocessor cores;

  - The company uses a full custom approach to design its chips, unlike Qualcomm and others, which tend to use an unstructured ASIC approach, which results in faster time to market but larger chips with greater power consumption;

  - Icera has developed its own proprietary instruction set architecture, microarchitecture and design tools after considerable performance modeling to understand design trade-offs in terms of processing delay, computational speed in operations per second, clock frequency, cost and power consumption;

- Icera's basebands can **dynamically repurpose silicon to the tasks required**, which has several advantages:

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- **Reconfiguration for different air interfaces on the fly**. In addition to real-time mode switching between (for example) EDGE and W-CDMA, this can also support simple firmware upgrades to allow an existing baseband to support new specifications without redesign;

- **Multiple sockets per design**. The ICE8040 supports 7.2 Mbps HSDPA / 2.0 Mbps HSUPA (Rel. 5, Type 3 interference reduction Rx). With software updates, the baseband can support up to 21 Mbps HSPA+ / HSUPA (Rel 7, 64 QAM). This effectively allows one part number to do the job of several. In contrast, Qualcomm has released at least three basebands to cover the same air interfaces as the ICE8040;

- **Minimum power consumption**. An Icera baseband can dynamically allocate silicon in real time depending on the channel conditions to minimize power consumption:

  - For example, the RAKE receiver can employ one finger instead of three during good reception conditions, or reduce the number of iterations used in turbo decoding. In contrast, competitors typically use fixed function designs that process for the worst channel conditions even under good conditions;

  - Icera's "IceClear" Type 3i equalization for interference cancellation is another example. The company claims to have shown that the proportion of users that can get 2 Mbps or better data reception can go from 33 percent to 85 percent with IceClear with little or no increase in power consumption. In comparison, a competitor's baseband has both Type 3i and standard demodulation running at the same time in silicon, which increases power consumption.

Icera's competitors point out that a truly **flexible baseband**, however implemented, should have **larger size** and **higher power consumption** than air-interface specific basebands. On the other hand, one usually expects a chip designed with full-custom logic to have **low power consumption but lack of flexibility**.

The founders and design team at Icera have devoted considerable effort to studying the trade-offs between flexibility and power consumption in terms of practical performance and cost as shown by conference papers and research articles published by the company. The company has approached the problem from a processor perspective, not from a wireless perspective:

Icera's approach implies steep upfront development costs, but the company can potentially make these up by targeting multiple sockets per design. Not coincidentally, Icera has raised over $200 million in funding, much of which has gone into chip development.

Company Background

Icera Semiconductor Technology Corporation [also known as Icera, Inc.] was founded in 2002 and is headquartered in Bristol, England. The company had 300 employees as of April, 2010. Icera has raised more than $200 million not counting funding raised by the acquired SiRiFIC, which makes Icera one of the most well-funded chip start-ups now in existence. The company has three R&D centres in the UK (baseband design), France (platform validation and operator approval) and the US (RF chip development). The company also has business development, customer support and service offices in Japan, Korea, Taiwan, China, US and Europe.

The company has filed applications for more than 160 patents to date. The VC-backed fabless chip company offers complete chipsets including basebands, transceivers and power management ICs. The company's founders have extensive experience in the design of power efficient digital processors.

Icera acquired SiRiFIC Wireless, a transceiver start-up, in 2008. SiRiFIC had raised approximately $63 million since its founding in 2001. The acquisition provided Icera with the ability to offer complete chipsets. Prior to the acquisition, Icera had raised $142 million. In December 2008, the combined company raised another $70 million, no small feat at the peak of the 2008 / 2009 global recession.

Many of the design team members originally worked for INMOS or companies in the INMOS lineage. INMOS developed media processors. STMicroelectronics acquired INMOS, which was later spun-out as Element 14, a company known for its DSL soft modems;

Broadcom acquired Element 14 in 2000, and went on to become a leading DSL modem supplier.

The company has postponed plans to issue public stock in 2010, but still hopes for an IPO within 18 – 24 months. An IPO could attract $1.5 billion to $2.0 billion if Icera continues to increase its revenue.

Baseband Product Portfolio

Since acquiring SiRiFIC Wireless in 2008, Icera has sold almost all basebands in complete chipsets that include Icera transceiver and often an Icera power management IC. When Icera introduced its first baseband in Japan, the company partnered with Infineon for transceivers. Later, Icera began a partnership with SiRiFIC that culminated in the acquisition of SiRiFIC.

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Icera targeted PC data applications in 2005 with the release of its first baseband, the ICE8020. This allowed the company to side-step most competitors, concerned as they were with supplying cellphone OEMs. Icera primarily provides its basebands to two segments of the mobile broadband market, embedded PC data modules and detachable modules (USB dongles). The company has a recent design-win in the Plastic Logic QUE eBook reader, and expects to expand into other broadband mobile devices and eventually smartphones.

Exhibit 2 Icera's Basebands

Feature	Livanto ICE8020	Livanto ICE8040	Livanto ICE8060	Livanto ICE9040
Target	USB Dongles, Embedded modules	USB Dongles, Embedded modules	USB Dongles, Embedded modules	USB Dongles, Embedded modules, Smartphones, Tablets, Ebook Readers
Air Interface	GSM/GPRS/EDGE/W-CDMA/HSDPA (3.6 Mbps)	GSM/GPRS/EDGE/W-CDMA/HSPA+ (21 Mbps DL / 5.7 Mbps UL)	GSM/GPRS/EDGE/W-CDMA/HSPA+ (42 Mbps DL / 11.4 Mbps UL)/LTE (50 Mbps DL / 25 Mbps UL)	LTE (100 Mbps DL / 50 Mbps UL)
Process Node	90 nm	65 nm	40 nm	28 nm
Footprint	12 x 12 mm	12 x 12 mm (PoP) / 10.5x10.5mm (BGA)		12 x 12 mm (PoP) / 10.5x10.5mm (BGA)
Processor Architecture	DXP	DXP	DXP	DXP
Display	NA	NA	NA	NA
Camera	NA	NA	NA	NA
Video	NA	NA	NA	NA
Audio	FR, HR, EFR, AMR	FR, HR, EFR, AMR	FR, HR, EFR, AMR	FR, HR, EFR, AMR
Connectivity/Interface Support	SIM	SIM, USB 2.0	SIM, USB 2.0	SIM, USB 2.0
Other On-chip Functions	Security engine, Reconfigurable baseband	Security engine, Reconfigurable baseband	Security engine, Reconfigurable baseband	Security engine, Reconfigurable baseband
Eng. Samples	Q4 2005	2008	2010	2011
Status	Available	Available	In development	In development

Source: Icera

Revenue and Competition

As a privately held company, Icera does not publicly disclose financial information. We calculate that Icera had close to **$50 million in revenue** in calendar 2009. With 300 employees, the company probably burns through

about $65 - $75 million per year in salary and overhead. Assuming a modest increase in sales, Icera should break even in 2010 and will probably generate a profit in 2011.

The company considers Qualcomm as its chief competitor, with ST-Ericsson a secondary threat. More recently **Huawei** entered the mobile broadband market with its own 10.2 Mbps baseband. The growth of the mobile broadband / data segment of the market will attract new players such as Infineon, Broadcom and potentially Intel. In addition, several baseband start-ups plan to enter the market by 2011 with LTE products, among these Sandbridge, Coresonic, Comsys, Altair Semi and many of the WiMAX baseband suppliers.

- Based on our discussions with Icera, the majority of the company's revenues in 2009 came from baseband sales to USB dongle manufacturers, with some additional revenue from slim modems for embedded PC data applications;

- We estimate that Icera generated almost 80 percent of its revenues from basebands, 15 percent from transceivers and 5 percent from power management ICs in 2009;

- More than 30 global mobile operators have approved Icera chipsets, including AT & T, Telefonica, Vodafone and Softbank.

The company announced its first handset design win in mid-2008, although it did not amount to any real shipments. By this time, the company had begun offering its basebands in reference designs such as the Express 300 targeting feature phones and smartphones, not just data cards:

  - By including applications processors from third parties such as TI, Icera hopes to compete with Qualcomm, ST-E, MediaTek and Infineon in smartphones;

  - Although Icera could extend its microarchitecture to include on-chip applications processing, this would probably dilute its performance advantages over competitors already established in baseband-apps processors.

Icera plans to launch its first 40 nm baseband in 2010. The baseband will be part of a chipset that will support five to six LTE bands in addition to quad-EDGE and five UMTS bands. The company expects to ship products into smartphones by 2011.

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Implications

Icera has established itself as a credible supplier of slim modem basebands as well as complete chipsets for mobile broadband data with technology that sets the company apart:

- Icera appears to have a **one to two year technology lead** on mainstream suppliers Qualcomm, ST-E and Infineon in the slim modem space in terms of size, power consumption and reconfigurability. This should help the company win share in LTE as volumes ramp in 2011;

- Other start-ups developing reconfigurable basebands, we would argue, have relatively unproven solutions, basebands with less configurability, or basebands optimized for single-mode operation.

Icera will face intense competition in LTE basebands and chipsets, but we believe that the company has the right technology to maintain and improve its current position in embedded and detachable modems, and to expand into smartphones with the evolution to LTE in the future.

Contact Information

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