

COGNOVO LTD
KEY DATA: FACT FILE

Technology
Software-defined modem

Established
2009

Type
Spin-out by ARM Ltd

Location
Melbourn (near Cambridge)

Employees
37

Funding
Undisclosed, funded by ARM and the founders

Executive Chairman
Tony Milbourn
One of the founders of TTPCom when it demerged from TTP plc and floated on stock market in 2000; acquired by Motorola in 2006; when Motorola restructured the founders established Cognovo in Spring 2009.

Cognovo is about to change the way that the radio modem, at the core of every mobile phone, will be designed. The Company is led by the team that built TTP Communications to a £540 million IPO in 2000. As further evidence of capability it has the backing of ARM, the dominant designer of microprocessors by volume shipped.



LEGACY

Cambridge has great depth in wireless, dating back to pre-war days of radio (Marconi and Pye). The region also boasted the research laboratories of British Telecom, Plessey and STL, which were world leaders in their field. There remains a vibrant undergrowth of wireless expertise, which emerged first in such pioneering ventures as Sinclair Radio, and then in a swathe of mobile wireless start ups.

Motorola acquired TTPCom in 2006. When it restructured the following year the four founders decided to team up to use their deep knowledge of the industry to create another business, licensing IP out of universities. However, the Lehman Crisis put an end to their start up fund raising. The founders then decided to follow their own intuition. This told them a software-defined modem was what the industry needed. It was deliverable they told themselves, if they could find the 'missing piece': the processor on which to run the software.

Software-defined modems were already developed for base stations but no-one had found a way to develop a software-defined modem for a handset which would still meet consumer expectations on cost and battery life. For example, Icera Semiconductor, founded by the same team that created Element 14 in Cambridge, have developed a soft modem, which is successful in USB 3G dongles for laptops, but its power consumption is too high still for handsets, according to Cognovo.

However, Icera's device is likely to become an option for use in handsets in the future. In this case, the decision for the handset maker is whether to buy in modem chips (Icera is a fabless supplier), or have more control of the supply chain by doing the software themselves and sourcing a modem platform from traditional semiconductor vendors.

ARM COLLABORATION

The search for the 'missing piece' did not take long, as it turned out to be under their nose in Cambridge. In Q2 2009, weeks after deciding to focus on the SDM business, they received a phone call from Warren East, CEO of ARM, who had a proposition to make.

ARM's interest lay in a Vector Signal Processing (VSP) technology it had acquired after working with a micro processor design company in Belgium, Adelante, in an EU funded Framework programme to develop a new type of audio processor. It acquired the company in 2003 in order to exploit Adelante's powerful VSP technology and development tools, which enables high data throughput processing applications.

ARM had also recognised the opportunity for the VSP in the modem field and had developed an optimised processor/compiler pair for this application, based on a collaboration with the University of Michigan in the USA. Once ARM discovered that the ex-TTPCom team was starting a company to enter the same field, it saw an opportunity to transfer ARM's know how to the new company in return for 15% in the new company's enlarged business. To help capitalise the enlarged company it also provided further funding via a convertible bond which will increase ARM's stake when shares are sold later.

THE PROPOSITION

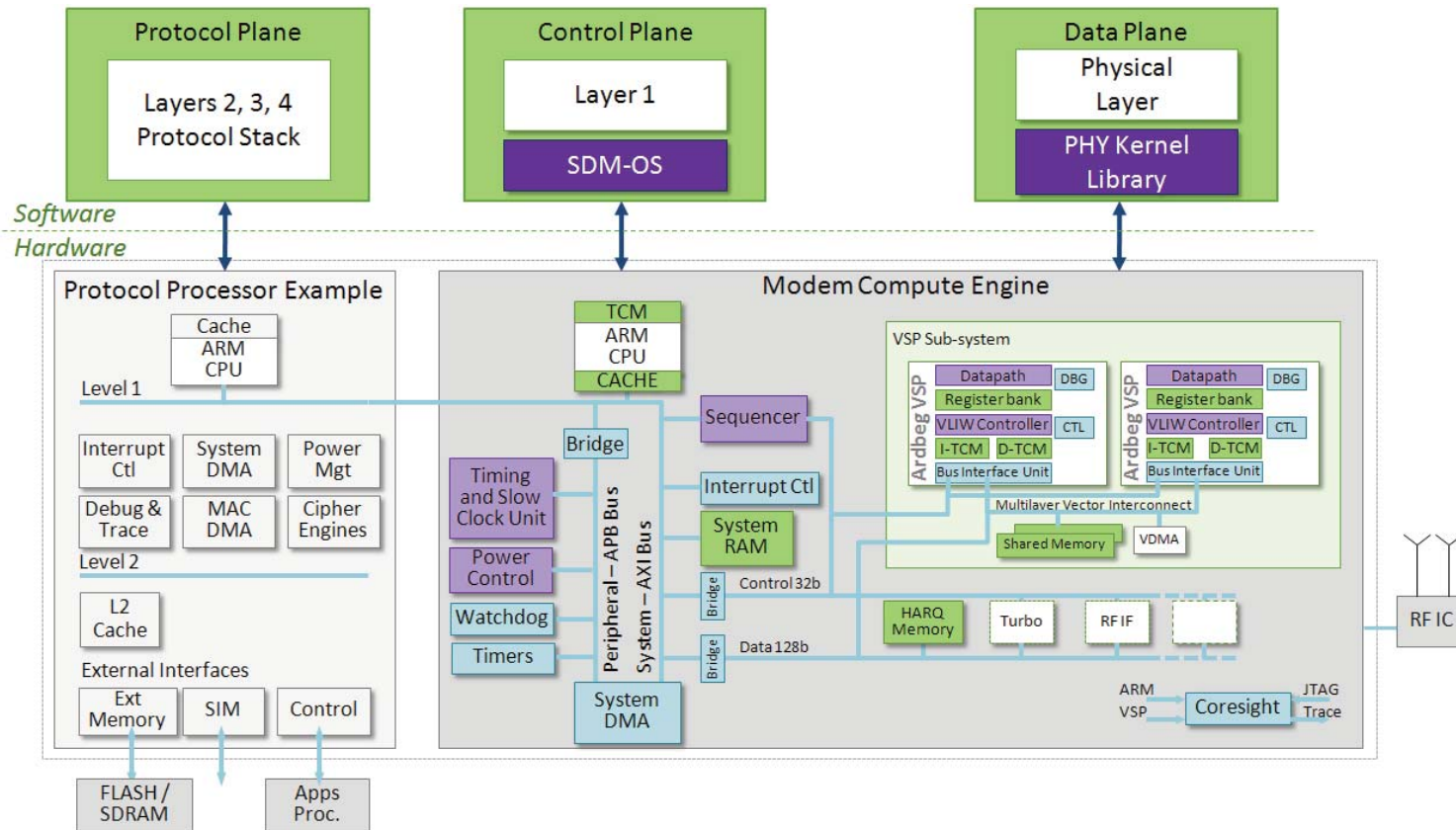
Cognovo's starting point is the belief that reconfigurable architectures will be necessary to support multiple wireless technologies and standards, including both new and legacy ones, such as LTE, HSPA+, EDGE, GPRS, GSM, TD-SCDMA, CDMA2000, IS-95, Bluetooth, WiFi, WiMax, and GPS. However, to design a processor which can handle a multiple of different standards is not trivial. To put it in perspective, the latest wireless standards require around 100 thousand million computing operations per second. This is the same order as the computing power of the latest Intel server blade chipsets, yet these need over 100 watts of electrical power. A mobile phone, by comparison, has to do the same number of operations, using only milliwatts of power, and with chips costing only a few dollars.

The huge computing requirements mean that hand set makers have to make major investments in chip design in order to adapt to new features in the wireless standards. To reduce this investment wireless modems are designed using a combination of standard processors and dedicated calculating hardware (in the form of ASICs). The resulting design process however is lengthy and the modem design tends to be inflexible.



MODEM COMPUTER ENGINE

The Ardbeg Vector Signal Processor (VSP) lies at the heart of the Execution Environment. Its novel architecture and instruction set are optimised for wireless algorithms. Ardbeg is capable of performing several instructions per clock cycle on data arrays. A typical device would include two or more Ardbegs; as well as a standard ARM microcomputer core. The processors alone are not enough, so Cognovo has developed a novel Sequence Processor to solve the problem of managing tasks efficiently across multiple processors yet still ensure that the system can meet tight processing deadlines (a critical problem that inhibits the general take-up of parallel processing). The Sequence Processor also manages resource usage to minimise power consumption and memory required. An implementation includes these elements below with other functional blocks to form the Modem Computing Engine (MCE) which is the basic hardware block that Cognovo licenses. The MCE is targeted at the next generation of cellular standards, LTE, as well as legacy standards, including WCDMA, CDMA2000/EVDO, and EGSM.



SOLUTION

Cognovo saw that this problem could be overcome if the modem functionality could be defined as a software program for a computer, which was independent of the hardware design. In this case the modem function could be changed by software without needing any hardware change.

To implement the functionality in software would need a low-power, low-cost computing platform - that was also very powerful - also a non trivial challenge to achieve. It believes the Vector Signal Processor technology from ARM's Adelente investment provides this because it is designed for wireless algorithms and has the capability to meet the computing requirement at the necessary level of power consumption. Cognovo's founders add to this the knowhow to design a system which can use this platform in the most effective way. The result is what they call a 'Modem Computer Engine' (see diagram on previous page) which provides the multi processing capability required to manage different standards in software.

THE INDUSTRY

What is immediately striking about the mobile wireless market is its overall size and its continuing growth. Currently there are 1.2 billion handsets sold a year. Ericsson has estimated that 50 billion devices (not only mobile handsets) could be wirelessly connected by 2020. By way of comparison there are around 560 million TVs sold each year and 200 million laptops. By 2020 the same source estimates there will be nearly 6 billion people using mobile communication devices.

Today, the handset market is dominated by a small number of manufacturers, including Nokia, Samsung, and LG. There is a sub-stratum of rapidly growing specialist players, such as RIM

which makes the Blackberry. There are new players entering the market, such as Apple and Google, who have strong brands in associated markets; and then strong Chinese players such as Huawei, HTC and ZTE are starting to play globally as well.

On the semiconductor side, after a series of consolidations, there are effectively three large-volume suppliers of 3G-capable chipsets to the major manufacturers - Qualcomm, ST-Ericsson, and Infineon, while Renesas will join this group following the purchase of Nokia's modem design business. Qualcomm in particular has achieved a very strong position built on technical excellence and the strength of their patent portfolio. A Taiwanese manufacturer, Mediatek, dominates the 2G market, but they have yet to make comparable inroads in 3G.

When a major new standard is agreed, handset vendors are nowadays keen to embed their own IPR. To do so they have to invest in developing suitable chip designs themselves (for example Samsung and LG have both developed their own early chips for the first time). They make themselves even less dependent on existing suppliers by using silicon foundries for chip supply instead.

Where Cognovo sees the opportunity is to help handset vendors to reduce the cost of development of new handsets as well as the cost of the device itself. By defining the modem in software it allows handset vendors to design devices for different combinations (e.g. HSPA/LTE, CDMA2000/LTE) at less cost because they can share the same silicon. Other benefits Cognovo believes are reduced time to market, simplified manufacturing (as there are potentially multiple sources of silicon), and the aggregation of product volumes across more product lines, which reduces cost.

As a result, Cognovo believes, handset companies and semiconductor suppliers can bring better products to market, more quickly, at lower cost.

PRODUCTS

Cognovo is offering vendors two product families: an Execution Environment (which combines computing hardware and system software) and a Design Environment (software development tools). The Ardbeg Vector Signal Processor (VSP) (named after the Islay whisky) lies at the heart of the Execution Environment. The Protocol Framework (a future product) will support the incorporation of existing protocol stacks and provide an Object-Oriented environment for the development of new ones.

The business model is the same as ARM's, offering a license to the software design in return for a large upfront license fee and a 'pretty small' per unit royalty on sales. As its chairman, Tony Milbourn notes, there are about 40 mobile phones manufactured every second, 'so the royalty doesn't need to be very big'. To convert companies into 'believers' is still a challenge, however: companies want a silicon chip to test and not just a software simulation. Cognovo began by thinking this step could be avoided, says Milbourn, but it turns out the industry is more conservative. However, with the first licence in place a reference exists and they are starting to see the market move.

Once adopted, Cognovo's modem will pose a serious problem for the established players. How will they react? Well, as Milbourn says, they too can buy Cognovo technology, just as they do ARM processors.

GOALS

Cognovo's founders do not intend to stop at the mobile handset market either. With the tools the company has in place it will be possible to address a variety of other markets. These include even more sophisticated cellular standards, other wireless and communications systems, and processing-intensive areas, such as image and video processing (which as it happens is where Adelente began).

As for the future, the company plans to be a 'high-margin licensing business' by 2014, when royalties are expected to make a strong contribution. By 2018 it is projecting revenue of \$100m a year and to be 'very profitable'. The option then says Milbourn is to use retained earnings to fund new opportunities for the core technology. In short, big goals and everything to play for. ■

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