Background

Until 2006, NXP was the semiconductor business of Philips Electronics N.V. In 2006, a group of private equity investors led by KKR and Bain Capital acquired 80.1% of the business in a leveraged buyout, paying an average of $26.07 per share. Four years later, with the global economy emerging from the Great Recession, and with NXP more than $5 billion in debt, the investors sold the majority of their interest through an IPO which valued the stock at $14 per share. The private equity investors began to sell down their remaining shares in March 2011; the remainder, approximately 7%, was sold in May 2014.

NXP Acquires Freescale Semiconductor

On March 2, 2015, NXP announced it had entered into an agreement to merge with Freescale. Freescale shareholders will receive $6.25 in cash and 0.3521 of an NXP share for each share of Freescale they hold. The purchase price implies a total equity value for Freescale of approximately $11.8 billion and a total enterprise value of approximately $16.7 billion, including Freescale’s net debt.

The merger will make NXP the world’s largest automotive semiconductor supplier, but that could change some months from now if NXP decides to jettison some Freescale product lines. NXP has a history of supporting only products where it is the leading market share holder. There is a small amount of overlap in the merged product portfolio. For example, both companies produce in-vehicle networking transceivers. Freescale is already in the radar business and NXP is working on CMOS radar. Freescale’s line of MEMs pressure and acceleration sensors is, however, complementary. Freescale also brings a strong lineup of automotive qualified 8-bit, 16-bit and 32-bit microcontrollers, all of which will be complementary to NXP’s automotive portfolio. Freescale is especially strong in the powertrain domain and in motor control.

The merger brings two of Freescale’s largest automotive customers into NXP’s world: TRW and Denso.
Relative Market Share (RMS)

If there is one thing that distinguishes the NXP automotive business unit from its competitors it is its extremely high relative market share. NXP calculates relative market share by dividing NXP’s market share on a dollar basis by the market share of the next largest vendor in the target market. Remarkably, 90% of NXP’s Automotive business unit revenue comes from products that have a relative market share that is significantly greater than two. NXP has a dominant market share in all three of its core application segments: secure car access, in-vehicle networking and car entertainment.

According to the company: “RMS is a critical management tool at NXP as the company believes that if it can achieve an RMS of at least 1.5x in a large, growing target market the following trends develop: (1) It can out-invest, in terms of R&D investment, all competitors in the target market due to inherent revenue scale; (2) It can achieve first mover advantage; (3) It can derive a disproportionate amount of early cycle market profitability; (4) It can evolve as the “thought leader” in a target market for the OEMs who buy within the market.”

One of the main benefits of high relative market share is its leverage on R&D spending. If all the competitors spend 13.5% of revenue on R&D as NXP does, NXP’s absolute R&D spend would be more than twice as large. “That lets us make better, more innovative products. It is our recipe for success in the semiconductor markets we serve. That is not just automotive but across the board at NXP,” asserted Kurt Sievers, executive vice president and general manager of the Automotive business unit.

High relative market share usually leads to high profitability. NXP Semiconductors reported a net margin of 9.5% for 2014, with the automotive business unit performing somewhat better.

Three Core Automotive Product Sectors

Secure Car Access

◆ One-Chip Passive Keyless Entry/Go

In 1995, NXP launched its secure car access portfolio with an electronics immobilizer and later a remote keyless entry system. NXP’s secure car access chips are now designed into vehicles from 18 of the top 20 carmakers. More than one billion car keys have been shipped with NXP chips.

Today NXP’s biggest seller is its passive keyless entry and keyless go system. With a passive system the driver doesn’t need to press a button on a key fob; the key fob can stay in the pocket and the doors unlock as the driver approaches. The car is started with the push of a button.

“Passive keyless entry/keyless go has been available to drivers of premium vehicles for many years,” said Mr. Sievers. “But now the feature is being made available in B- and C-segment vehicles. We have a huge share of that market and now the market is expanding.”

NXP recently introduced a one-chip implementation of this system that is so small it can be packaged in a wearable device such as a smartwatch. “It is the first of its kind and the smallest of its kind,” said Mr. Sievers. “This opens up a whole new field of use cases that go beyond the traditional key fob.”

◆ Near Field Communications (NFC)

NXP is offering a portfolio of automotive qualified NFC controllers. Now that every major smartphone maker, including Apple, has adopted near field communications capability in at least some of their devices, the door is open to finding NFC use cases for the vehicle. “The one application that is being implemented now is simplified Bluetooth pairing,” said Mr. Sievers. “You simply hold your smartphone against the instrument cluster and the Bluetooth connection is automatically established. There is no need to have a complicated procedure of entering PIN codes. That is something we are shipping this year.”

Other applications that link an NFC-equipped smartphone with the car key are available.

In-Vehicle Networking

Shipping more than six billion in-vehicle networking transceivers per year, NXP claims to be the world’s largest supplier of the devices. With the exception of MOST,
NXP covers all vehicle communications buses: LIN at 20 kbit/s, CAN at 1 Mbit/s, FlexRay at 10 Mbit/s and Ethernet at 100 Mbit/s. NXP makes the physical layer devices, which connect the wires and the microcontrollers.

The market for networking chips is growing, according to Mr. Sievers, from 25 nodes per vehicle in 2014 to 38 nodes per vehicle in 2019. “Electronics content is increasing. The number of electronic modules that are networked is increasing. The number of nodes is actually accelerating. Every new car these days has an average of ten NXP in-vehicle network ICs, the majority of them for the CAN bus,” he said.

**FlexRay**

FlexRay, the safety-critical, in-vehicle networking protocol pioneered in the early 2000s by NXP and Freescale with support from BMW and Daimler, is a good example of NXP’s approach to the automotive market. It invests early in technology and patiently waits for the market to develop. NXP has had to be very patient with FlexRay. While the technology still hasn’t reached its potential, sales of FlexRay devices are finally picking up.

FlexRay first appeared in a production vehicle, the BMW X5, in 2006. “Today FlexRay sales numbers are still pretty small, but we are seeing significant interest from many car OEMs worldwide who are implementing deterministic [safety-critical] applications such as steer- and brake-by-wire,” said Mr. Sievers. “There are no substitutes for FlexRay. Once a car OEM makes the decision to use FlexRay and makes the initial investment, that carmaker is more likely to apply it to other applications. That drives up the number of FlexRay nodes per car and that is driving growth for us.” With more ADAS applications coming, Mr. Sievers expects demand for FlexRay chips to grow rapidly at least until 2020.

**Ethernet**

Ethernet is the newest network communications protocol to find automotive applications. “Ethernet is going to be really big,” declared Mr. Sievers. “BMW was the first to use it as a link for diagnostics and flashing. Now it is being used to link surround-view camera images. It is also being applied to multimedia entertainment systems. Soon we will see it used to connect to radar sensors and to the V2X module. And as carmakers move toward domain architectures, it will be used as a backbone link between domain controllers.”

In 2011, NXP joined with Broadcom, Freescale, Harman, BMW and Hyundai to establish the OPEN Alliance Special Interest Group to promote the wide-scale adoption of Ethernet-based automotive connectivity. Some high-end cars will have as many as six Ethernet nodes by 2018, but the mass market for Ethernet devices will develop after 2020. NXP offers two Ethernet devices, a physical layer chip and a switch.

**Car Entertainment Products**

NXP owns the number-one global share in car entertainment semiconductors. One of its standout products is a hybrid digital and analog solution, which integrates the tuner and digital signal processor on a single chip.

Strong evidence of NXP’s capability in entertainment semiconductors can be found in its success with the Japanese tier-one infotainment system suppliers, who together own a large piece of the global entertainment system market. Japanese automotive electronics manufacturers strongly favor Japanese suppliers, except when the alternatives are clearly superior. “Every single Japanese tier one is using NXP silicon,” noted Mr. Sievers.

**Software-Defined Radio**

A big part of NXP’s market leadership in entertainment semiconductors is a result of its software-defined radio receiver, which the company also refers to as a global multi-standard digital radio receiver. “In the past every carmaker in the world bought the same thing, an analog AM/FM radio,” explained Mr. Sievers. “It was simple; you make one radio and ship it all over the world. Now with digital radio, that has become much harder. In India, for example, you have Digital Radio Mondiale; in the United States you have SiriusXM satellite radio and HD Radio from iBiquity; in Canada you have DAB. Different countries require different receivers.”

As a solution to this problem NXP offers software-defined radio receivers. “Every radio, regardless of where it is shipped, gets the same hardware,” said Mr. Sievers. “At the end of the production line the receiver is configured with the software appropriate for the countries where the car will be operated.”

**Most Promising Future Products**

**ADAS**

Of all the automotive applications addressable by NXP, the company sees ADAS (advanced driver assistance system) applications as its fastest growing over the next five to ten years. ADAS needs sensors to build a digital image of the car’s surroundings. “That typically requires analog mixed-signal technology and then transferring into digital signals, which is exactly where NXP is very strong,” Mr. Sievers noted. NXP has been investing in two high-frequency, highly integrated, mixed-signal CMOS devices for ADAS: radar and secure vehicle-to-vehicle (V2V) communications.
**Secure V2X**

In 2017, Cadillac will become the world’s first carmaker to embed V2X transceivers, supplied by NXP, in its vehicles. The baseband processor applied in the V2X chip set is similar to the processor that underpins NXP’s software-defined radio chip sets, which lead the car entertainment market. V2X technology is very much in the company’s sweet spot: not only does NXP provide the V2X chip set, it also supplies a cybersecurity controller to protect the system against hackers. Further, NXP’s V2X product includes media access and physical layer software developed by Cohda Wireless that conforms to the 802.11p communications standard. NXP is Cohda Wireless’ largest investor. Cadillac’s tier-one supplier for V2X is Delphi.

Cars with V2V transceivers will be able to tell each other how fast they are going and where they are headed, data that will help to avoid collisions. V2V will perform like sensors that can “see” around curves and through buildings and have a greater range than radar.

Several other carmakers have issued RFQs for V2V implementations that will launch in 2018. None of these early implementers are waiting for government mandates. The earliest mandate could come from the U.S. government but not until at least 2018 and it would include a three- to four-year phase-in period.

NXP’s V2X chipset has been deployed in several field tests in the U.S. and Europe. The company expects the market for all V2X chips to reach $250 million by 2020 with an average selling price between $15 and $20. Given its early investment in V2X technology, NXP expects to win a relative market share of two or greater.

Thinking beyond vehicle-to-vehicle or vehicle-to-infrastructure applications, V2X chips could also be deployed in smartphones or other small devices carried by pedestrians and bicyclists. “That would provide a great protection mechanism for kids,” said Mr. Sievers. Device makers will only begin to seriously consider installing V2P (vehicle-to-pedestrian) chips once a sufficient number of V2X vehicles are on the road.

<table>
<thead>
<tr>
<th>Distinctions Claimed by NXP</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1 worldwide in car entertainment*</td>
</tr>
<tr>
<td>#1 worldwide in in-vehicle networking*</td>
</tr>
<tr>
<td>#1 worldwide in secure car access*</td>
</tr>
<tr>
<td>#5 worldwide in automotive magnetic sensors</td>
</tr>
<tr>
<td>#2 worldwide in Class D amplifiers</td>
</tr>
<tr>
<td>#1 automotive semiconductor supplier in China</td>
</tr>
<tr>
<td>World’s first to develop two-way, long range RF keys</td>
</tr>
<tr>
<td>World’s first to develop NFC-enabled smartphone vehicle access</td>
</tr>
<tr>
<td>World’s first to develop one-chip radar solution</td>
</tr>
<tr>
<td>World’s first design win for production V2X chips</td>
</tr>
</tbody>
</table>

*In each of these markets, which together account for more than 90% of the automotive business unit’s revenue, NXP’s market share is more than twice the market share of the number-two supplier.

**Radar Sensors**

Today automotive radar sensors are typically built using multiple silicon germanium chips, a somewhat exotic technology that can’t easily be up-integrated. NXP has developed prototype silicon for what it claims is the world’s first 77-GHz RF CMOS device that can be fully up-integrated with the baseband. The transceiver, signal generation and analog-to-digital conversion are integrated in the CMOS device. The new sensor has not been released to the market yet but according to Mr. Sievers, NXP is in serious discussions with a number of customers.

An important attribute of NXP’s new CMOS radar sensor is its applicability to both long- and very short-range views, so short that it will compete with ultrasonic sensors, which have been used for many years in parking applications to sense curbs and adjacent bumpers. “Because it is implemented in CMOS, this sensor can do perfectly what an ultrasonic sensor does,” claimed Mr. Sievers. “By eliminating the ultrasonic sensor you have fewer sensor types. That simplifies the algorithms that fuse the sensor outputs. I have customers who are working toward that point. Ultimately there will be no more ultrasonic sensors in the car,” he predicted.

Another advantage of CMOS radar is its small size compared to silicon germanium radar. NXP’s will be a postage-stamp-sized module that can fit into odd places in the car such as the bumpers or mirrors. NXP is a late comer to the radar market, but expects that its RF CMOS radar will be able to carve out a significant piece of the market, which is expected to reach $400 million by 2020.

**Secure Elements**

Carmakers are well aware of the potential for cyberattacks and are considering how best to defend against them. NXP has been producing secure elements (crypto-controllers) for banking cards and passports and anticipates that carmakers will use these aboard the vehicle to defend each communications portal, for example the V2X module and cellular modem.

**Strategic Collaborations**

**Audi**

To improve its speed of innovation, in 2012 Audi signed an agreement with NXP to cooperate in key electronics segments including in-vehicle networking, car entertainment, wireless reception, V2X communications, telematics, near field communications, radar and high-voltage controls. An example of high-voltage controls is in-vehicle network transceivers in components connected to a 48-volt power supply.

“...The agreement gives us the opportunity to learn about Audi’s future needs unfiltered by a tier-one supplier,” said Mr. Sievers. “We get experience with use cases five and even ten years in advance of the market.” Audi is an especially good partner because they are often first to market with innovative automotive electronics technology. NXP has tested its V2X communications chip set in an Audi field trial.

**Delphi**

In an agreement announced in February 2013, Delphi made NXP one of its strategic core suppliers. The agreement covers a variety of automotive semiconductor applications including infotainment and networking. The two companies have cooperated for more than 20 years. ◆