Automotive: Driverless Cars
Who will win the race?

USA | TECHNOLOGY | SECTOR REVIEW

Driverless Cars
Google kick started the race to develop the first self-driving car, beginning in 2009 and as of 2013, four US states have passed laws permitting autonomous cars: Nevada, Florida, California, and Michigan. Many others, Apple and Tesla to name a few, have since jumped on the bandwagon and are competing to develop the first commercially viable autonomous vehicle.

Driverless cars (self-driving car or autonomous), with the ability to pilot themselves with no need for human input besides starting point as destination, could change everything from the way we commute, the way we approach personal ownership of cars and so on.

Hailed as the next new disruptive technology poised to change the way we live, it is no longer a question of “if” but rather “when” autonomous cars will arrive, with some companies estimating the first truly autonomous car within the next 5 years. In this overview, we will take a look at how the technology works and a few potential companies that are positioned to take advantage of this next frontier of technology.

How it works?
Autonomous Vehicles rely on inputs from sensors all around the vehicle itself and on their software to interpret the information picked up by the sensors before translating the information into action.

Hardware components:

- **Sensors:** Radars, cameras, lidars as well as GPS would be examples of some of the sensors needed to be embedded into the vehicle itself to enable the vehicle to drive itself. As of now, most of these technologies are already present in most cars although for truly autonomous driving to take place, the degree of accuracy would have to be improved. GPS for example is currently accurate in metres, but for autonomous driving it would need to be accurate in centimetres at the very least.

- **Processors (CPU):** The amount of information the sensors would accumulate would be incredible; visual data, motion data, speed and positioning etc. The on-board Processors in Autonomous Vehicles would have to be able to not only handle the constant stream of information, it would need to do so in real time and without lag, since the consequence of lag could potentially be deadly. In this case, processors do exist that could process the information, although the cost of such high end processors at current time could impede wide spread application.

- **Graphics Processing Unit (GPU):** A specialised electronic circuit designed to rapidly manipulate and alter memory to accelerate the creation of images in a frame buffer intended for output to a display.

- **Internet Connectivity:** Autonomous Vehicles would require internet connectivity on the go, in order for the on-board computers to be aware of traffic conditions, ideal routes etc. An interesting development that might see greater application is **V2X Communication.** If the technology is successfully developed and implemented into Autonomous Vehicles, it would allow fleets of vehicles to form ad-hoc networks or cloud, allowing vehicles to exchange information such as other vehicles’ speed, positions as well as potential obstacles.
Software:

- **Operating Systems**: If the previous hardware for Autonomous vehicles could be likened to the senses and brain of humans, the Operating System (OS) could be likened to our consciousness, making the decisions once the information has been processed. Here many companies are scrambling to be the first to breakthrough in writing the program that would be competent enough to not only understand the myriad of situations the Autonomous vehicle might find itself in, but also be able to make the correct decision, in the correct time frame. Driving is extremely complex, with many variables apt to change in the blink of an eye, and any OS must be able to adapt and adapt quickly. As of yet, many companies are still striving to perfect their OS and while much progress has been made, there is still much room for improvement.

- **Other software**: High Definition maps will also need to be required if Autonomous vehicles are to pilot themselves with minimal input from human passengers. The User Interface (UI) will also need to be developed and it remains to be seen how the UI of future Autonomous vehicles will be implemented.

How a self-driving car works

Implementation:

Semi-autonomous vehicles are already in use and included in features of everyday cars and in certain sectors, fully autonomous vehicles have already been implemented.

**Features already available:**

- **Parking assistance** – using cameras and sensors to drive the vehicle into the parking space has been available since 2006 outside Japan, which had the technology in a primitive form since 1999.

- **Adaptive cruise control** – using radar or lidar to allow the vehicle to adjust its speed with respect to traffic has been available in Japan since 1997.

- **Automatic Emergency Brake** – Mercedes-Benz first premiered the technology to the world in 1996.
While semi-autonomous features have been accepted by the world, greater strides in autonomous technology will need to be made before fully autonomous vehicles can be widely implemented.

However, within certain sectors, essentially fully autonomous vehicles have started to make some headway:

- **Trucking/Public Transport**: In America, labour cost for the trucking industry account for a huge portion of total cost. Therefore, companies in this sector are keen to implement autonomous vehicles that would allow them to transport more goods at a lower cost. Despite high wages, the arduous job with long, lonely and monotonous task sees a high turn-over rate with drivers. Autonomous Trucks could help alleviate that bottleneck in operations. Freightliner/Daimler and Volvo have started to test autonomous trucks on roads in USA.

- **Mining**: Rio Tinto has rolled out fully autonomous truck fleets at two of its iron ore mines in Western Australia, in the first of what they call their “Mine of the Future”. Rio Tinto currently has a fleet of 69 autonomous trucks already hauling iron ore within their mines in Pilbara.

It is likely that within the next 5-10 years, more semi-autonomous features will be added to mass market cars, with greater and greater autonomy given to the car’s processor until fully autonomous cars are acceptable to the market.

**Timeline:**

When fully Autonomous Vehicles finally arrive, it is likely, as with most new technologies, that it would be made available at a premium price. The higher cost of certain components such as the higher grade GPS and radar or lidar would make cost prohibitive for car manufacturers (OEM) to mass produce, hence Autonomous Vehicles should first be available as premium units. Subsequently, as the cost of components start to lower and the idea of autonomous vehicles become more prevalent and accepted, OEMs would start to mass produce Autonomous Vehicles to meet demand.

Currently, according to a Volvo survey, 92% of drivers still wish to be able to take control of the vehicle. It is likely that while the technology is still new, there is an inherent mistrust in the technology. Based on how long it took previous semi-autonomous features took to become mainstream, we estimate that it would take about 10-15 years, assuming there has been no major incident involving Autonomous Vehicles, for the technology to become widespread and accepted. If we reach that stage, it is possible in the future for fleets of Autonomous Taxis to take the place of personal car ownership, although such a scenario would be beyond the current scope of this overview.

**Company projected timeline**

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>Electronic Stability Control mandated in USA</td>
</tr>
<tr>
<td>2014</td>
<td>Electronic Stability Control mandated in EU</td>
</tr>
<tr>
<td>2018</td>
<td>Elon Musk expects first fully autonomous Tesla, approval by 2021</td>
</tr>
<tr>
<td>2020</td>
<td>Google, Toyota, Ford and other manufacturers expected to release autonomous vehicle</td>
</tr>
<tr>
<td>2025</td>
<td>USA Secretary of Transportation expects driverless cars to be in use globally</td>
</tr>
<tr>
<td>2030</td>
<td>Uber CEO expects that Uber’s fleet will be fully driverless by 2030</td>
</tr>
</tbody>
</table>

Sources: Company, PSR
Potential Companies (price as at 15/03/16)

**Hardware:**

**Cisco Systems, Inc (NASDAQ: CSCO) @ US$27.70:** CSCO is a world leader in networking equipment. With the advent of Autonomous Vehicles, demand will increase for wireless networking equipment. Additionally, together with NXP Semiconductors, CSCO have invested into Cohda Wireless, an Australian company working on V2X communication technology. Margins on sensors and networking equipment are not very large, but CSCO could benefit from the increase in volume. The stock is currently trading at 13.7x historical PER, which we feel is slightly undervalued, with a 3.75% dividend yield, the 5 year average PER is 14.4x.

**Delphi Automotive (NYSE:DLPH) @ US$70.06:** Delphi Automotive is amongst the car industry’s largest suppliers, and in recent times, that has included pioneering many of the technologies that are on the cutting edge of automobiles. In the previous CES shows, the company showed off a concept of autonomous car. The car, based on an Audi, included many different technologies needed for an autonomous vehicle. DLPH does not sell directly to the public, but the different elements of the car would be up for sale to different car manufacturers. DLPH is well positioned to take advantage of the advent of Autonomous Vehicles, regardless of who wins the race for producing the first commercially viable self-driving car.

DLPH is currently trading at 17x historical PER, with a 1.66% dividend yield, which we feel is slightly undervalued. The 5 year average PER is 14.3x.

**Mobileye (NYSE:MBLY) @ US$34.35:** a technology company that develops camera-based advanced driver assistance systems (ADAS), their technology senses obstructions and lanes and alerts drivers of impending collisions. MBLY would be a pure-play for investors looking for ADAS exposure. However there are risk that other companies, such as Google Inc, that could release their own product and be a competitor. Tesla had announced that Mobileye would be powering the autopilot feature in its Model S cars. MLBY is trading at 157.13x TTM PER. The company was listed only in 14 August 2015. Despite we like its strong growth story but we feel that it is near-term a bit overvalued.

**NVIDIA (NASDAQ: NVDA) @ US$32.30:** An American technology company based in Santa Clara, California. Their designs graphics processing units (GPUs) for the gaming market, as well as system on a chip units (SOCs) for the mobile computing. Since 2014, Nvidia has shifted to become a platform company focused on four markets - Gaming, Professional Visualization, Data Centers and Auto. Early this year, NVIDIA unveils world’s first in-vehicle AI supercomputer, Drive PX2. The Drive PX 2 is powered by Nvidia GPUs and has 360-degree situational awareness around the car. It is capable of processing the inputs of 12 video cameras, as well as lidar, radar, and ultrasonic sensors. The unit features water-cooling, to enable operation in severe conditions. NVDA is currently trading at 30.3x historical PER, with a 1.42% dividend yield, is look fairly value for now. The 5 year average PER is 20.8x.
Software:

Nokia (NYSE:NOK) @ US$6.06: Nokia with their Nokia HERE division is in a prime position to benefit from the advent of Driverless cars. Nokia bought over a map data provider Navteq in 2007. Since then, Nokia HERE has become the market leader for automotive embedded maps, providing in-dash navigation for 4 out of 5 cars. Driverless cars would likely need an extensive up to date maps on the on-board computer and Nokia has established background in providing those maps in cars. Nokia is purportedly also building a map database specifically for driverless cars. It could become a potential partner of car companies looking to add embedded maps into their driverless cars or even an acquisition target for other companies looking to improve their mapping programs. NOK is trading at 17x historical PER with a 2.57% dividend yield, which we feel is fairly valued.

Google (NASDAQ:GOOGL) @ US$750.24: Google was the first company to venture into this space and has a significant head start over many companies. They have started testing self-driving cars in California and other parts of USA. They claim to have self-driven over 1 million miles. Should Google succeed in making the first commercially viable autonomous car, it remains to be seen how they intend to monetize the breakthrough, whether it be by manufacturing the vehicles themselves or by licensing the program to other car manufacturers. Regardless, should Google be the first to succeed in this field, they are likely to reap much benefit from it. Google is trading at 32.9x historical PER, it does not pay a dividend, the 5 year PER average is 28.9x and we feel that Google is fairly valued.

Others:

Tesla (NASDAQ:TSLA) @ US$215.15: Tesla has also thrown its hat into the ring to produce autonomous vehicles. It has recently updated its Model S with the Summon function, allowing the car to park itself and then return to the owner. The electric car manufacturer has in recent times had its share price beaten down amongst tempered expectations, but should Tesla be able to produce the technology for autonomous driving, the company is likely to regain favor in the market again. Tesla is currently loss making and trades at about 215.15 USD per share, we feel that the share is overvalued at the moment.

Conclusion

In this report, we have taken a brief look into the autonomous vehicles sector and possible scenarios and companies that might benefit from its advent. The technology has vast implications for the transport sector as well as the daily lives of people all over the world. As such it represents a great opportunity for companies and their shareholders. The list above is not a comprehensive list of companies that stand to benefit from the wide scale adoption of autonomous vehicles, but does list a few key players as well as auxiliary players that might benefit as well. For other potential players, please see the appendix below.
Appendix:

Apple’s Project Titan

Market rumours has Apple developing a self-driving electric car. The company has hired several auto engineers from Tesla, Carnegie Mellon, Volkswagen, Nvidia, and A123 Systems, among others. They are rumoured to have a 2019 release date for their first electric vehicle (without the autonomous features).

Audi

Audi revealed its RS 7, which completed a lap on a Grand Prix track at racing speed, without a driver and are continuing development for further application of Audi piloted driving. Audi is owned by Volkswagen, which is traded on the Frankfurt Exchange.

Baidu And BMW

Baidu and BMW have partnered to produce a self-driving car for the Chinese market, Baidu reports its two prototype BMW 3 Series Gran Turismo driverless vehicles has completed successful test through the streets north of Beijing. In late last year, Baidu has also joined Chinese electric car maker BYD to develop the company’s AutoBrain system, a software package that would be the key to its autonomous driving goals. The software uses different technologies, like object recognition and 3D road mapping, to improve the performance of its driverless vehicle.

Ford intensifies its research on Autonomous vehicles

Ford announced that it is tripling its fleet of fully autonomous test vehicles this year, as well as announcing its intentions to take its autonomous cars to the streets of California for testing.

Honda

Honda received approval last year to test its autonomous vehicles on public streets in California, joining Google and many others in the testing phase for the new technology.
Important Information

This report is prepared and/or distributed by Phillip Securities Research Pte Ltd ("Phillip Securities Research"), which is a holder of a financial adviser’s license under the Financial Advisers Act, Chapter 110 in Singapore.

By receiving or reading this report, you agree to be bound by the terms and limitations set out below. Any failure to comply with these terms and limitations may constitute a violation of law. This report has been provided to you for personal use only and shall not be reproduced, distributed or published by you in whole or in part, for any purpose. If you have received this report by mistake, please delete or destroy it, and notify the sender immediately.

The information and any analysis, forecasts, projections, expectations and opinions (collectively, the “Research”) contained in this report has been obtained from public sources which Phillip Securities Research believes to be reliable. However, Phillip Securities Research does not make any representation or warranty, express or implied that such information or Research is accurate, complete or appropriate or should be relied upon as such. Any such information or Research contained in this report is subject to change, and Phillip Securities Research shall not have any responsibility to maintain or update the information or Research made available or to supply any corrections, updates or releases in connection therewith.

Any opinions, forecasts, assessments, estimates, valuations and prices contained in this report are as of the date indicated and are subject to change at any time without prior notice. Past performance of any product referred to in this report is not indicative of future results.

This report does not constitute, and should not be used as a substitute for, tax, legal or investment advice. This report should not be relied upon exclusively or as authoritative, without further being subject to the recipient’s own independent verification and exercise of judgment. The fact that this report has been made available constitutes neither a recommendation to enter into a particular transaction, nor a representation that any product described in this report is suitable or appropriate for the recipient. Recipients should be aware that many of the products, which may be described in this report involve significant risks and may not be suitable for all investors, and that any decision to enter into transactions involving such products should not be made, unless all such risks are understood and an independent determination has been made that such transactions would be appropriate. Any discussion of the risks contained herein with respect to any product should not be considered to be a disclosure of all risks or a complete discussion of such risks.

Nothing in this report shall be construed to be an offer or solicitation for the purchase or sale of any product. Any decision to purchase any product mentioned in this report should take into account existing public information, including any registered prospects in respect of such product.

Phillip Securities Research, or persons associated with or connected to Phillip Securities Research, including but not limited to its officers, directors, employees or persons involved in the issuance of this report, may provide an array of financial services to a large number of corporations in Singapore and worldwide, including but not limited to commercial / investment banking activities (including sponsorship, financial advisory or underwriting activities), brokerage or securities trading activities. Phillip Securities Research, or persons associated with or connected to Phillip Securities Research, including but not limited to its officers, directors, employees or persons involved in the issuance of this report, may have provided advice or investment services to such companies and investments or related investments, as may be mentioned in this report.

Phillip Securities Research or persons associated with or connected to Phillip Securities Research, including but not limited to its officers, directors, employees or persons involved in the issuance of this report may, from time to time maintain a long or short position in securities referred to herein, or in related futures or options, purchase or sell, make a market in, or engage in any other transaction involving such securities, and earn brokerage or other compensation in respect of the foregoing. Investments will be denominated in various currencies including US dollars and Euro and thus will be subject to any fluctuation in exchange rates between US dollars and Euro or foreign currencies and the currency of your own jurisdiction. Such fluctuations may have an adverse effect on the value, price or income return of the investment.

To the extent permitted by law, Phillip Securities Research, or persons associated with or connected to Phillip Securities Research, including but not limited to its officers, directors, employees or persons involved in the issuance of this report, may at any time engage in any of the above activities as set out above or otherwise hold an interest, whether material or not, in respect of companies and investments or related investments, which may be mentioned in this report. Accordingly, information may be available to Phillip Securities Research, or persons associated with or connected to Phillip Securities Research, including but not limited to its officers, directors, employees or persons involved in the issuance of this report, which is not reflected in this report, and Phillip Securities Research, or persons associated with or connected to Phillip Securities Research, including but not limited to its officers, directors, employees or persons involved in the issuance of this report, may, to the extent permitted by law, have acted upon or used the information prior to or immediately following its publication. Phillip Securities Research, or persons associated with or connected to Phillip Securities Research, including but not limited to its officers, directors, employees or persons involved in the issuance of this report, may have issued other material that is inconsistent with, or reach different conclusions from, the contents of this report.

The information, tools and material presented herein are not directed, intended for distribution to or use by, any person or entity in any jurisdiction or country where such distribution, publication, availability or use would be contrary to the applicable law or regulation or which would subject Phillip Securities Research to any registration or licensing or other requirement, or penalty for contravention of such requirements within such jurisdiction.

This report is intended for general circulation only and does not take into account the specific investment objectives, financial situation or particular needs of any particular investor. The products mentioned in this report may not be suitable for all investors and a person receiving or reading this report should seek advice from a professional and financial adviser regarding the legal, business, financial, tax and other aspects including the suitability of such products, taking into account the specific investment objectives, financial situation or particular needs of that person, before making a commitment to invest in any of such products.

This report is not intended for distribution, publication to or use by any person in any jurisdiction outside of Singapore or any other jurisdiction as Phillip Securities Research may determine in its absolute discretion.

IMPORTANT DISCLOSURES FOR INCLUDED RESEARCH ANALYSES OR REPORTS OF FOREIGN RESEARCH HOUSES

Where the report contains research analyses or reports from a foreign research house, please note:

(i) recipients of the analyses or reports are to contact Phillip Securities Research (and not the relevant foreign research house) in Singapore at 250 North Bridge Road, #06-00 Raffles City Tower, Singapore 179101, telephone number +65 6533 6001, in respect of any matters arising from, or in connection with, the analyses or reports; and

(ii) to the extent that the analyses or reports are delivered to and intended to be received by any person in Singapore who is not an accredited investor, expert investor or institutional investor, Phillip Securities Research accepts legal responsibility for the contents of the analyses or reports.