In the cross-hairs of ADAS & Connected Car: V2X Primer

What's Incremental To Our View

V2X is an Advanced Driver Assistance System (ADAS) technology that complements sensor-based ADAS and is a critical component in the "connected car". Investors and companies viewing the "connected car" as the next big mobile computing platform should understand its strategic importance, and the relevant suppliers, particularly NXPI. We believe this technology may be an important strategic factor in QCOM's reported interest in acquiring NXPI.

- V2X is a critical automotive technology that sits in the cross-hairs of two mega-trends: ADAS & the connected car. This emerging technology enables cars (Vehicles) to communicate (X) with other cars, infrastructure, and other objects (X). Unlike sensor based ADAS that uses cameras, radars, and lidars, V2X uses digital messaging to understand a car's surroundings. Unlike 4g and 5g communications technologies that link cars to the network, V2X links cars directly to each other and to infrastructure (e.g., traffic lights) without passing through a wider network.

- V2X is a strategically important market for semi companies. Just as innovation's shifting from PCs to mobile devices changed the fortunes of semiconductor companies years ago, we anticipate innovation's shifting to the automotive end market will change the fortunes of semiconductor companies today. The automotive market's unit count may not be huge (100 million units compared to 1.4Bn smartphones and 500m PCs), but this market's stable and diversified OEM base, high appetite for differentiated (expensive) technology, and structurally high switching costs make it a strategically important market for semiconductor suppliers. V2X's presence in the cross-hairs of ADAS & connected car mega-trends highlights its strategic importance. In fact, we believe this technology may be an important strategic factor in Qualcomm's (QCOM, $67.71, NR) reported interest in acquiring NXPI.

- Market structure is shallow & narrow but getting deeper & wider. While companies have been experimenting with V2X technologies for over 15 years, we believe the commercial market generates prototype level sales, afforded to 8 suppliers. With General Motors (GM, $31.60, NR) deploying the technology in limited volume in 2017 and another top 3 OEM following suit, expect V2X technology to ramp slowly. We expect that by 2030 V2X will achieve 54% penetration of vehicle production + additional infrastructure penetration, translating to 120 million units, and $3.0 billion in sales.

Companies Impacted in This Note

<table>
<thead>
<tr>
<th>Ticker</th>
<th>Price</th>
<th>Rating</th>
<th>Target</th>
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<tbody>
<tr>
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<tr>
<td>NXPI</td>
<td>$100.64</td>
<td>Buy</td>
<td>$104.00</td>
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• **While V2X is not central to our thesis, the investment vehicle remains NXPI.** NXP (NXPI, $101.64, Buy) is an important automotive technology vendor, supplying a wide variety of microcontrollers, application processors, RF interfaces, networking interfaces, radar solutions, and other products including V2X. We expect NXP's V2X sales will ramp from zero today to $15m in CY17 and $100m in CY20, reflecting rapid growth, and strategic value, despite its modest contribution even in the next five years. Our bullish stance on NXP is more fundamental: Even with the recent run in the shares, investors pay only 14.5x CY17 PF EPS for what we anticipate will be mid-teens EPS growth owing to idiosyncratic revenue growth drivers, margin expansion, and effective capital allocation.

• **MBLY investors need to understand V2X.** In the long-run we expect V2X will be complementary to Mobileye's (MBLY, $37.84, Buy) and other vendors' sensor-based ADAS solutions. However, in the near-term, we acknowledge two complications that V2X introduces for MBLY and its ilk:
  - **(1) Percent of BOM.** V2X will compete for budget with other ADAS solutions, and
  - **(2) Architectural challenges.** As OEMs and tier-1 vendors deploy V2X and sensor-based ADAS in the same vehicles, they will require a new technology, whether "sensor fusion" or something else to coordinate the messages delivered from these disparate systems.
In the cross-hairs of ADAS & Connected Car: V2X Primer

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In the cross-hairs
Investors are broadly aware of the electronic content growth story evolving in the automotive end market. Three megatrends underlie this content growth story. They are:

1. **Efficiency**, which is influenced by regulations of fuel economy, and our collective desire for a clean environment,
2. **Safety**, which is influenced by legislation and the high value we place on human well-being, and
3. **Connectivity**, which is driven by the desire to inform and entertain drivers and passengers.

V2X is a critical automotive technology that sits in the cross-hairs of two mega-trends: Safety & the connected car.

![Exhibit 1: V2X sits in the cross-hairs of 2 automotive megatrends: safety and the connected car](source: STRH Research)

V2X is an Advanced Driver Assistance System (ADAS) technology that complements sensor-based ADAS and is a critical component in the "connected car". Investors and companies viewing the "connected car" as the next big mobile computing platform should understand its strategic importance, and the relevant suppliers, particularly NXPI. We believe this technology may be an important strategic factor in QCOM's reported interest in acquiring NXPI.

This emerging technology enables cars (Vehicles) to communicate (2) with other cars, infrastructure, and other objects (X). Unlike sensor based ADAS that uses cameras, radars, and lidars, V2X uses digital messaging to understand a car's surroundings. Unlike 4g and 5g communications technologies that link cars to the network, V2X links cars directly to each other and to infrastructure (e.g., traffic lights) without passing through a wider network.

**How it works**
V2X is a set of technologies that allows vehicles to wirelessly communicate with other vehicles (V2V), infrastructure (V2I), pedestrians (V2P), and other objects around them. In a V2X system, vehicles and other objects can communicate among each other at distances above a half mile and without direct line of sight. The following visual should give readers a sense of the breadth and diversity of objects that could benefit from such a system.
We anticipate that V2X systems will complement sensor-based ADAS systems. For example, sensor-based ADAS can identify lane markings and deliver lane centering in a way that V2X cannot. However, V2X can “see” traffic signals through fog, while camera-based ADAS cannot. Also, while camera-based ADAS systems can see upcoming traffic lights, a V2X system could calculate exactly when the light will change status, enabling a car or driver to manage speed in a more fuel efficient way.
In the following exhibit, we show a complete ADAS system combining more traditional sensor-based ADAS with V2X offering long-range redundancy as it communicates with other vehicles and infrastructure. It is important to note that V2X is primarily intended to be a complementary feature, rather than a cannibalizing technology on sensor-based systems.

Exhibit 3: V2X offers a redundancy for other ADAS modalities

V2X benefits that are difficult to achieve with more traditional sensor-based ADAS systems range from safety features like “do not pass warning,” and “emergency vehicle warning”, to convenience features like traffic assistance and platooning.

Exhibit 4: V2X specific use cases

Source: NXPI
Driver & societal benefits

We believe V2X offers a variety of safety and other benefits, which we describe below.

Improving driver safety

Over 35,000 people were killed on U.S. roads in 2015. We believe that reducing the number of driver fatalities is the most important benefit derived from ADAS technology in general, and V2X is an important part of the solution. While many safety features will come from sensor-based ADAS systems, V2X’s unique abilities to “see” farther and through/around other objects allows V2X to enhance stand-alone sensor-based solutions.

![Exhibit 5: 2015 saw the largest uptick in auto related fatalities in the US in 50 years](image)

Source: NHTSA, STRH Research

Improving pedestrian safety

Approximately 5,000 pedestrians are killed each year in the U.S. alone. Pedestrian fatalities and injuries are an area where V2X can incrementally benefit the ADAS system from three perspectives. First, the vehicle will be able to communicate with pedestrians’ cell phones to estimate pedestrian location and trajectory to help avoid contact. Second, the vehicle can communicate with traffic lights and walk signals, gaining further data about where pedestrians should be standing or walking. Third, because these signals can communicate through other vehicles and around buildings, vehicles will be more aware of pedestrians and cyclists that are not in direct view, but could be on a colliding path nonetheless. For example, if a person walks out of an alleyway, a vision-based system or a human can only see the person when he is in full view, but a V2X system could be aware of the pedestrian’s path beforehand.

Reducing the cost of accidents

The NHTSA estimates crashes cost the economy approximately $300 billion per year. Similar to driver fatalities, reducing (and ultimately eliminating) vehicle crashes is the ultimate goal of ADAS systems. While safety is obviously the most important goal, the cost from car crashes is a huge burden on individuals, as well as on the larger economy. V2X’s long-range communication and prediction capabilities will allow it to incrementally improve the ADAS system and reduce traffic crashes.
Reducing the cost of traffic jams
According to a recent Texas A&M study, U.S. commuters spend approximately 42 hours a year stuck in traffic jams, and V2X systems could significantly reduce this. Sensor-based ADAS solutions cannot predict the timing of traffic lights, as well as what is occurring with vehicles well in front of them. V2X, and specifically Vehicle-to-Infrastructure (V2I), can. Because V2X systems can communicate with upcoming traffic lights, and determine the speed and location of surrounding vehicles, V2I will be in a unique ability to optimize traffic speed and adjust traffic patterns to optimize fuel efficiency and reduce time spent in traffic.

Technology Enablers
There are various technology enablers that make V2X possible including in-vehicle networks, ex-vehicle networks, hardware & software security, processors, and software. A high level visual of the various technology enablers are pictured in the following exhibit, and we elaborate on each below.

### Exhibit 6: V2X technology enablers

<table>
<thead>
<tr>
<th><strong>Freescale</strong></th>
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<tr>
<td><strong>NXPI</strong></td>
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<tr>
<td><strong>Software Defined Radio 802.11p Modem</strong></td>
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<tr>
<td><strong>Ethernet</strong></td>
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</table>

**Strong value proposition**
- Innovation leader in secure V2X
- Highest performance
  - 1.5 Miles distance
  - 5 msec latency
  - Field-tested by Audi

**Powerful system play**
- Integral software + hardware solution
- Scalability
- Secure element

Source: NXPI

In-vehicle networking
Many years ago electric signals in automobiles were connected via dedicated wires. However, in the 1980s, as information processing in the vehicle expanded, automobile manufactures saw the advantages of networking objects on the car to reduce the number of connections and wires. In-vehicle networking (IVN) was born. The following exhibit demonstrates the myriad of internal communications networks within today’s automobiles.
**Exhibit 7: Today’s car is lined with a myriad of communication networks**

**CAN**
Controller Area Network (CAN) is a message-based protocol that was designed to allow microcontrollers and devices to communicate with each other in a real-time system. Equipped with different sensors, the CAN will be able to monitor the different systems that are important to the vehicle’s safety and function as each node in the data network has the capability to receive and send signals. CAN systems are widely used in low data rate control applications and are not as likely to be replaced by newer technologies as some other network protocols within vehicles.

**Flex-Ray**
FlexRay is an automotive network communications protocol that is faster and more reliable than its predecessor CAN, but is not as powerful as Ethernet. FlexRay supports data rates of up to 10 Mb/s per channel. The technology was originally intended for chassis applications, before being transitioned to powertrain and safety electronics applications. With the network acting as deterministic and fault-tolerant, it is used in many safety-critical applications such as: Drive-by-Wire, Steer-by-Wire, lane assistance, collision avoidance, and others. The FlexRay system utilizes a dual channel architecture that can offer system wide redundancies needed for emerging safety standards, as well as work in a hierarchical system with LIN and CAN networks. FlexRay could potentially see its market opportunity diminish if Ethernet were to be widely accepted.

**LIN**
The local interconnect network (LIN) is a cost-effective communications protocol that is mostly used for automotive body control applications. This technology is meant to be a low-cost alternative to the controller area network (CAN) in areas where speed and bandwidth are not critical. LIN represents an
opportunity to save costs, and is typically used in lower-end models and applications where the CAN bus is too expensive.

**MOST**
Media Oriented Systems Transport (MOST) is a common multimedia network protocol that focuses on applications within vehicle infotainment. The protocol is optimized for communications over plastic optical fiber or electrical conductor that deals with audio, video, voice, and data signals. This standard was developed by SMSC, which was acquired in 2012 by Microchip (MCHP, $60.64, Hold).

**Ethernet**
In-vehicle Ethernet is a cost-effective, data networking technology that can be used with many in-vehicle networks, such as engine control, multimedia systems, and sensors. As vehicles add more sophisticated technologies such as multiple cameras and lane keeping systems, Ethernet provides an option to connect the different applications. This technology is still relatively new, and as such, the potential usage and standardization of the applications are still being discussed. Ethernet is gaining momentum through its simple physical implementation and speed.

The following exhibit summarizes the use cases for in-vehicle networks.

<table>
<thead>
<tr>
<th>Exhibit 8: In-vehicle networks varied use cases and characteristics</th>
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<tbody>
<tr>
<td><strong>Bus</strong></td>
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<td><strong>Domains</strong></td>
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<td><strong>Applications</strong></td>
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<tr>
<td><strong>Data rate</strong></td>
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<td><strong>Relative Cost</strong></td>
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<td><strong>Physical layer</strong></td>
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**Source:** STRH Research

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**Ex-vehicle networking**
Two technologies are available to connect a vehicle to an external network: (1) direct two-way communication, supported by Dedicated Short Range Communications (DSRC), and (2) mobile networks, supported by 3g, 4g and 5g technologies.

**Direct Short Range Communication (DSRC)**
This technology is an open-source protocol for wireless communication, similar to Wi-Fi. DSRC enables two-way, short to medium range wireless communications that facilitate high speed data transmissions directly between objects, without passing through a centralized network. DSRC spectrum was allocated for this function approximately 17 years ago, stemming from the government’s approval of 802.11. While 802.11 is the basis for Wi-Fi, 802.11.p extends the standards for vehicular communication systems. Although many industry participants have been experimenting and deploying low unit count systems using an 802.11.p network, unit volumes in deployment remain low. Some companies such as QCOM
have even petitioned the FCC to take back the spectrum used to support DSRC, so they can attempt to deliver V2X over the second modality – mobile networks (i.e. 3g, 4g, 5g, etc.).

**Mobile**

In this framework, vehicles, buildings, and other infrastructure would be connected to a larger wireless network – the same one that supports mobile phones. Communication speeds may ultimately be faster than they are with DSRC; however, mobile support for V2X introduces two complications: first is the latency introduced with communicating through a wider area network; second, is the density of mobile networks: if a driver is in a low-density mobile area, his V2X system may not work effectively.

We expect the FCC to make a determination about whether or not to in mid-2017 as to whether to retain DSRC spectrum or return it to the Wi-Fi community.

**Hardware & software Security**

In any instance where wireless communication features are added to a device, the security and privacy associated with the system becomes an important concern. Considering V2X involves vehicles, personal devices, buildings, traffic lights, and many other items, the integrity of the entire system will be paramount. For consumers and governments to gain confidence in the usefulness of V2X, the manufacturers are taking a multi-pronged approach to security, involving three critical features:

- **Authentication**: accurately identifying the other members of the network
- **Integrity**: ensuring each message has not been adjusted by another party
- **Nonrepudiation**: ensuring senders cannot deny sending a message after it’s been sent
- **Autonomy**: ensuring messages can be tracked and identities uncovered

**Processors**

While V2X is based on an external communication network, without a processor to create outgoing messages and understand and respond to incoming messages, the idea does not work. Therefore in order to deliver a complete functioning system, a vehicle’s ability to process and react to the enormous amount of data is increasingly important. Examples of V2X processors include NXP’s RoadLINK SAF5100 and QCOM’s Snapdragon 820A family.

**Software**

As much as V2X relies on advances in hardware, it is the software that is often cited as the most important and challenging to deliver aspect of a V2X system. We believe building up messages to transmit is a relatively straightforward task, but making sense of the potentially overwhelming number of messages being potentially received by a V2X system is the challenging part. Software in these systems is designed to accomplish all of the critical safety and traffic management features identified earlier in this report.

**Strategically important market**

Semiconductor companies’ ability to grow and flourish depends significantly on their ability to identify shifts in platform demand. Investors are acutely aware that a shifting tide took growth out of the PC (desktop and notebook) industry, while supporting significant growth in the smart phone industry. We show how this trend, in particular from 2011-2014, afforded QCOM with significant revenue growth, but left INTC’s revenue growth stagnant.
Exhibit 9: Company’s growth can be largely dependent on whether they guess right on emerging technology trends

Source: FactSet, IDC, STRH Research

Just as innovation’s shifting from PCs to mobile devices changed the fortunes of semiconductor companies years ago, we anticipate innovation’s shifting to the automotive end market will change the fortunes of semiconductor companies today. The automotive market's unit count may not be huge (100 million units compared to 1.4 billion smartphones and 500 million PCs), but this market's stable and diversified OEM base, high appetite for differentiated (expensive) technology, and structurally high switching costs make it a strategically important market for semiconductor suppliers.

Within automotive, certain applications offer more structural growth – specifically anything related to the three mega-trends of fuel efficiency, safety, and connected car. Because V2X is in the cross-hairs of two of these megatrends, it seems its exposure to semiconductors should be viewed as highly desirable, even though sales for V2X systems are de minimis today.

While we believe the primary factor supporting QCOM’s reported interest in acquiring NXPI is financial accretion and revenue diversification, we believe an important strategic aspect of such a combination would be NXP’s strong position in V2X. We highlight some of the rationale for a business combination below.

- **Significant potential accretion for QCOM.** Financially, recent transactions in semis have valued targets at ~4.5x PF sales, ~16.0x PF EBITDA. Even if QCOM paid this price for NXPI, which equates to a takeout price of $124 for NXP, we estimate QCOM could achieve over 30% EPS accretion.
- **Diversifies QCOM sales.** An acquisition of NXPI would help diversify QCOM’s revenues away from handsets, going from >95% today to ~70%, and give QCOM a meaningful presence in automotive, industrial, network infrastructure, and identification end markets.
• **Strategic fit – where 1+1 could be >2.** While there may be many areas in which closer collaboration between the two vendors could drive significant growth, there are a few opportunities that jump out to us, including:

  o **China.** While QCOM has had a somewhat bumpy relationship with Chinese OEMs, NXP has had an extremely favorable operating experience in China that could improve QCOM’s position.
  
  o **Digital Networking.** NXP’s digital networking business has been lagging, and we believe QCOM is one of the few acquirers that could realistically and properly invest in the business to return it to growth.
  
  o **NFC.** NXP’s leading position in NFC radios, secure elements, and software, may be more closely integrated with QCOM’s modems and processors.
  
  o **Automotive.** Notwithstanding NXP’s broad automotive product exposure, from microcontrollers, to application processors, to RF interfaces, radios, and radar solutions, we believe NXPI’s V2X presence would seal QCOM’s fate in establishing a solid footing in the strategically important V2X market.

**Market structure: shallow & narrow, getting deeper & wider**

While companies have been experimenting with V2X technologies for over 15 years, we believe the commercial market generates prototype level sales, divided among eight suppliers, but with (we believe) most of the revenue going to NXPI. With GM deploying the technology in limited volume in 2017 and another top 3 OEM following suit, expect V2X technology to ramp slowly. By 2030, we expect penetration to reach 54% of vehicle production + additional infrastructure penetration, 194 million units, and expect the semiconductor opportunity to reach $4.8 billion.

**Early adoption is shallow & narrow**

Several recent developments point to NXP as the primary winner in V2X semis:

• **In September 2014,** NXPI announced that it would be the world’s first supplier to deliver V2X chipset for mass-production to Delphi. The deal will place NXP’s RoadLINK V2X solutions in GM’s Cadillac 2017 models.

• **In March 2016,** HARMAN (HAR, $80.36, NR), announced a collaboration with NXP for V2X based on NXP’s RoadLINK technology.

• **In April 2016,** the European Truck Platooning Challenge leveraged NXP Secure V2V and radar technology in effort to improve fuel efficiency, emissions, safety, traffic flow and fleet efficiency in the European Union.

• **In June 2016,** NXP announced that it had partnered with the DoT on its Smart City Challenge initiative. The winner of the competition, Columbus, Ohio, will use NXP solutions, including real-time V2X communication systems and secure public transportation smart cards, for a more intelligent urban transportation system.

• **Looking forward,** NXP has announced that it is working with another top 3 OEM partner for further deployment of V2X solutions. Although the company won’t disclose the OEM, we believe it is Volkswagen (VOW-DE, €135.15, NR), as its sub Audi performed an extensive field test of NXP Semiconductors and Cohda Wireless V2X technology in Germany in 2015.
Exhibit 10: NXPI has already made progress in V2X

<table>
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<tr>
<th>Customers, Partners &amp; Field Trials</th>
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<tr>
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<td>DAF Trucks</td>
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<td>U.S. Gov</td>
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<td>Harman</td>
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- SoP MY2017 (Delphi)
- EcoTwin truck platooning
- Smart City Challenge USA
- Harman platform design win

Source: NXPI, STRH Research

Expect legislation to deliver step-functions of growth

We expect proliferation of V2X to be driven through a combination of consumer pull for higher levels of ADAS in vehicles as well as government mandates. We expect that these future legislations could provide step functions of growth.

The NHTSA itself recently noted that third party research indicates a mandate will be needed to spur investment in infrastructure and applications. We expect a significant financial commitment to continue, with the DOT expanding pilot / early adopter sites, and manufacturers and states beginning to make deployment announcements. At a 2016 presentation at ITS America, it noted that V2X is “an unprecedented and transformative technology...provides awareness of hazards not visible to the driver...and improves current systems.” We believe this support could help spur new legislation in the future.

As we have noted in the past, legislation has historically been the big driver behind adoption of technology in the automotive end market. Some examples include:

- **Seat belts.** The first seat belt law was a federal law, which took effect on January 1, 1968, that required all vehicles (except buses) to be fitted with seat belts in all designated seating positions.
- **Air bags.** On September 1, 1998, the Intermodal Surface Transportation Efficiency Act of 1991 went into effect, requiring that all cars and light trucks sold in the United States have air bags on both sides of the front seat.
- **Sensors.** Federally mandated emissions standards have driven significant adoption of various efficiency and particulate emission systems that consume significant electronic sensor content. Reflecting primarily a concern for environmental and health issues, governments have increasingly legislated ever-tighter emissions standards for new automobiles. Meanwhile emission standards will tighten meaningfully again in 2017 owing to implementation of Tier 2, Bin 2 requirements in the U.S., and implementation of RDE in Europe, Euro 5 in China, and Euro 4 in India.
The new, approved amendment is the standard required for adding wireless access in vehicular environments that are used to support vehicle-to-vehicle and vehicle-to-infrastructure (V2X) communications. DSRC (via 802.11.p) will serve as a critical impetus for further development and acceptance of V2X systems as, like many advanced systems, initial deployment will be driven by government mandates and support.

- **In Europe** NXPI, Honda (7267-JP, Y3,081, NR), Siemens (SIE-DE, E107, NR), and Cohda Wireless successfully ran the Corridor Test Drive that spanned 1,300km of road across Germany, Austria and the Netherlands in 2014 using V2X.
- **In the US**, NXPI has been in discussions with Secretary of the US Department of Transportation Anthony Foxx who earlier this year confirmed that a proposed mandate should go out sometime during 2016.
- **Singapore's** Ministry of Transport (MOT) and port operator PSA Corp. signed an MoU to jointly develop autonomous truck platooning technology for transporting cargo between port terminals in late 2015. The Land Transport Authority (LTA) is expected to create an electronic road pricing (ERP) called ERPII which can charge motorists for the distance they travel in the priced zones. Plans are to launch in the 2019/2020 timeframe.
- **In South Korea** there are plans for a V2X mandate in the 2020 timeframe.

<table>
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<th>Government</th>
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<tr>
<td>• Mandate expected 2016E</td>
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<td>• Corridor test drive (AT, DE, NL)</td>
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<td>• ERPII launch 2019E / 2020E</td>
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<td>• Plan to mandate for 2020E</td>
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**Source:** NXPI

### Sizing the market

As V2X becomes more widely available from competing vendors, and because we expect users to find the technology compelling, we anticipate level 4-5 ADAS (highly autonomous / fully autonomous vehicles) to proliferate. Our conversations with industry participants lead us to believe that V2X capability will become a necessary redundancy to achieve level 4-5 ADAS.
Exhibit 12: We expect L4-5 ADAS levels to require V2X integration

Higher Levels of Automation Need Many Complementary Sensors

Secure V2X

Radar

Lidar

Ultrasound

Camera

Commercial viability to be determined

Source: Company Data, and STRH Analysis

Thus we expect its penetration of global production to somewhat mirror level 4-5 ADAS penetration, although it will likely be lumpier, with less continuous growth, as we expect adoption to be more driven by government mandates that other forms of ADAS. In the following exhibit we demonstrate our anticipation for V2X penetration.

Exhibit 13: We estimate that V2X penetration rises from 2% in 2020 to 52% by 2030

Source: Company Data, and STRH Analysis

We estimate that the market for V2X in vehicles will reach 54% penetration, 65 million units, and $1.6 billion sales by 2030.
Exhibit 14: We estimate accelerating penetration will keep the V2X market growing through 2030

*Source: Company Data, and STRH Analysis*

In addition to vehicle penetration, we believe there will be a proliferation of V2X attached to infrastructure, for example, traffic lights. We conservatively expect the market for the “X” of V2X to be smaller than the vehicle borne market. We estimate that the market for V2X infrastructure will reach 55 million units and $1.4 billion sales by 2030.

Exhibit 15: We estimate that the market for V2X infrastructure be smaller than the vehicle market

*Source: Company Data, and STRH Analysis*
Combining these estimates, we expect V2X technology to ramp slowly, but achieve 54% penetration of vehicle production + additional infrastructure penetration by 2030. This translates to 120 million units and $3.0 billion in sales by 2030.

Exhibit 16: The V2X market could grow to $3.0 billion by 2030

Source: Company Data, and STRH Analysis

How to invest in V2X: Buy NXPI

As we show in the following exhibit, we believe there are eight semiconductor or component IP suppliers involved in V2X, a handful of software companies, and several other supply chain partners. However, given NXP’s traction in this market, and even acknowledging that V2X revenue is *de minimis* today, we see NXP as the only meaningful investment vehicle in the V2X theme.

Exhibit 17: Current V2X players

Source: Factset, STRH Research

NXP is an important automotive technology vendor, supplying a wide variety of microcontrollers, application processors, RF interfaces, networking interfaces, radar solutions, and other products including V2X. We expect NXP’s V2X sales will ramp from zero today to $15m in 2017 and $100m in 2020, reflecting rapid growth, and strategic value, despite its modest contribution even in the next five years.
Our bullish stance on NXP is more fundamental: Even with the recent run in the shares, investors pay only 14.5x CY17 EPS (pro-forma for the standard products divestiture) for what we anticipate will be mid-teens EPS growth owing to idiosyncratic revenue growth drivers, margin expansion, and effective capital allocation. We continue to see $104 as NXP’s fundamental stand-alone value, and see $124 (well higher than the $110 reported transaction valuation) as NXP’s value as an acquisition target based on an average of ~4.5x PF sales and ~16x PF EBITDA.

MBLY investors need to understand V2X

In the long-run we expect V2X will be complementary to MBLY’s and other vendors’ sensor-based ADAS solutions. However, in the near-term, we acknowledge two complications that V2X introduces for MBLY and its ilk:

1. **Percent of BOM.** V2X will compete for budget with other ADAS solutions, and
2. **Architectural challenges.** As OEMs and tier-1 vendors deploy V2X and sensor-based ADAS in the same vehicles, they will require a new technology, whether "sensor fusion" or something else to coordinate the messages delivered from these disparate systems.
AVGO: Valuation and Risks
PT is $217 based on 16x (1x discount to peers) CY17 EPS of $13.54

Risks to achieving our PT include:

1) Customer concentration / handset demand trends
2) Integration & cost savings execution with BRC

INTC: Valuation and Risks
PT is $36 based on a consistent, peer P/E multiple of 13.5x our CY17 estimate of $2.68, and validated with a DCF analysis.

Risks to our PT include declines in the global PMI; a general decline in demand for electronic products and systems in Intel’s end markets generally, and lower demand for semiconductor products specifically; data center growth weakness; PC units falling more than expected; and new products' SAM does not materialize. Upside could come from positive trends in data center capex or PC units.

MBLY: Valuation and Risks

Valuation

Based on a combination of comparable company (multiple) analysis, and DCF analysis, we believe the stock is worth $63, representing 47% total return, demanding a Buy rating.

Risks

The company operates in a highly competitive and rapidly changing market landscape, both from a technological and competitive perspective. As a result, we believe that higher level ADAS & autonomous driving development will unfold in unpredictable ways. We acknowledge semiconductor companies, tier 1 automotive suppliers, and automotive OEMs are working on a multitude of autonomous driving cars. It seems clear to us that some of these efforts will succeed, and others will not. Despite these inherent risks, MBLY’s technical capability, competence in the market, and customer relationships will play a critical role in both traditional low-level ADAS and higher level autonomous driving solutions.

MCHP: Valuation and Risks

Valuation

PT is $62 based on 15.5x (at the low end of MCHP’s historical range owing to elevated financial leverage) our CY17 EPS of $3.98.
Target Price Risks

Risks to achieving our target price include reduced or increased demand for analog products and systems, supply-related risks (including disruptions to production, manufacturing or distributors), a reduction or increase in microcontroller content, a delay in product or technology development, competitive pressures from another company and the Micrel and Atmel integrations performing better than expected.

NXPI: Valuation and Risks

Valuation

$104 PT is based on a lifted 15x (better margin profile & leverage) applied to our CY17 EPS estimate of $7.46 minus 50c of expected dilution from the sale.

Target Price Risks

Risks to achieving our target price include reduced demand for electronic products and systems, supply related risks (including disruptions to production or manufacturing), a severe downturn in demand that hampers debt refinancing and paydown, and competitive pressures from another company.

Companies Mentioned in This Note

- Broadcom Ltd (AVGO, $173.65, Buy, William Stein)
- Intel Corporation (INTC, $35.10, Hold, William Stein)
- Mobileye NV (MBLY, $37.84, Buy, William Stein)
- Microchip Technology Inc (MCHP, $60.91, Hold, William Stein)
- NXP Semiconductors N.V. (NXPI, $100.64, Buy, William Stein)
- QUALCOMM Incorporated (QCOM, $67.71, NR)
- General Motors Company (GM, $31.60, NR)
- STMicroelectronics (STM, $8.12, NR)
- Skyworks Solutions, Inc. (SWKS, $78.49, NR)
- Qorvo, Inc. (QRVO, $57.29, NR)
- Cadence Design Systems, Inc. (CDNS, $25.74, NR)
- Synopsys, Inc. (SNPS, $59.45, NR)
- BlackBerry Limited (BBRY, $7.35, NR)
- Visteon Corporation (VC, $69.07, NR)
- Harman (HAR, $80.36, NR)
- Delphi Automotive (DLPF, $64.23, NR)
- Continental AG (CON-DE, Euro 173.30, NR)
- DENSO CORPORATION (6902-JP, Y4368.00, NR)
Volkswagen AG (VOW-DE, Euro 135.15, NR)
Honda Motor Co., Ltd. (7267-JP, 3081.00, NR)
Siemens AG (SIE-DE, Euro 107.00, NR)
Cohda Wireless (Private)

**Analyst Certification**

I, William Stein, hereby certify that the views expressed in this research report accurately reflect my personal views about the subject company(ies) and its (their) securities. I also certify that I have not been, am not, and will not be receiving direct or indirect compensation in exchange for expressing the specific recommendation(s) in this report.

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SunTrust Robinson Humphrey, Inc. makes a market in the following companies at the time of this report: AVGO, INTC, MCHP, NXPI

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**Rating and Price Target History for: Broadcom Ltd (AVGO-US) as of 10-25-2016**

![Price Target Chart](chart.png)

*Created by BlueMatrix*
Rating and Price Target History for: Microchip Technology Inc (MCHP-US) as of 10-25-2016

Rating and Price Target History for: NXP Semiconductors N.V. (NXPI-US) as of 10-25-2016

STRH Ratings System for Equity Securities

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The rating system effective as of Oct. 7, 2016:

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Buy (B) – the stock’s total return is expected to outperform the S&P 500 or relevant benchmark over the next 12-18 months (unless otherwise indicated)

Hold (H) – the stock’s total return is expected to perform in line with the S&P 500 or relevant benchmark over the next 12-18 months (unless otherwise indicated)

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Not Rated (NR) – STRH does not have an investment rating or opinion on the stock

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Legend for Rating and Price Target History Charts:

B = Buy
H = Hold
S = Sell
D = drop coverage
CS = Coverage Suspended
I = initiate coverage
T = transfer coverage

The prior rating system until Oct. 7, 2016:

3 designations based on total returns* within a 12-month period**

• Buy – total return ≥ 15% (10% for low-Beta securities)***
• Reduce – total return ≤ negative 10% (5% for low Beta securities)

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