Telematics Shipments: 25.0 Million units in 2016 to 81.7 Million units in 2024

- **North America**: eCall/Telematics highly dependent on car maker strategies
- **Europe**: eCall telematics highly dependent on regulatory activity and selected OEMs
- **Japan**: Navigation is still dominant, Telematics roll-out is led by Toyota
- **China**: Will be the #1 region for embedded Telematics shipments by 2021 (North America #2)
OEM EMBEDDED MODEM SHIPMENTS FORECAST - GLOBAL

Telematics Forecast 2016 vs. 2024 (25 Mil. units → 81.7 Mil. units)

- **2.5G Network**: 6.3 Mil units in 2016 to 0K units from 2020
- **3G Network**: 12.7 Mil in 2016 units to 5.6 Mil units in 2024
- **4G/LTE Network**: 6 Million units in 2016 to 67 Mil units in 2024
- **5G Network**: 9 Million units in 2024
- C-V2X coming soon!
Global Active Subscriptions Will Exceed 250 Million by 2022

Leading Regions:

- **North America**: Market Driver - Single Market
- **Europe**: Market Driver – eCall
- **China**: Market Driver – Biggest Global Car market
Connectivity, Mobility and Autonomy

01 Software is King
02 Recalls and Cybersecurity
03 Safety
04 Generate Revenue
05 Retain Customers
06 Gain Competitive Advantage, Differentiate
07 The Three phases of Data Monetization
IT’S THE SOFTWARE, STUPID!

Space Shuttle: 500,000 lines of code

Boeing 777: 3-4 millions lines of code

Mercedes S Class: 100 million lines of code

Source: Infotainment & Telematics Service
SOFTWARE RECALLS

Exhibit 1-1 Number of Vehicles Recalled in U.S. for Software-Related Issues

Source: CX3 Marketing
CONNECTIVITY KEY TO SECURITY

Expectations for this community

Share
- Submit threat intelligence
- Send us information on potential vulnerabilities
- Contribute incident reports and lessons learned
- Provide best practices around mitigation techniques
CONNECTIVITY AND DATA COLLECTION KEY

• Collision avoidance
• Automated driving
• Enhanced with artificial intelligence

Next-gen VWs to get Nvidia-powered AI at CES 2018

At CES 2018, Volkswagen and Nvidia announce a tech partnership that will let future cars recognize drivers and respond to their needs.

Battle to create HD map:
• Continental/Ygomi
• Intel/Mobileye
• HERE
• TomTom
• Ushr
• Civil Maps, Deep Map, et.al.
A connection between the CAN bus and TCU is essential to data monetization.
MULTIPLE APPLICATIONS, BUSINESS MODELS

• Audience measurement – Drive Time Metrics (Nielsen/Gracenote?) – REVENUE SHARE

• Usage-based insurance and claims management – Verisk, Lexis-Nexis, CCC, Octo, etc. – BOUNTY-STYLE LEAD GENERATION

• Customer relationship management (CRM) – service scheduling – Cox Automotive, DealerFX, Time Highway, etc. – LEAD GENERATION/DIAGNOSTIC ALERTS

• Traffic information – HERE, TomTom, INRIX, etc. – PAID FOR BY DOTs AND MUNICIPALITIES

• Parking and weather information – Parkopedia, HERE, INRIX, etc. – AS ABOVE

• Road hazard alerts – HERE – AS ABOVE

• Beginning of a shift away from subscription-focused monetization toward both direct (CRM) indirect (traffic, weather info etc.) monetization of data.
MARKET LEADERS

• BMW (CarData) and GM (Global Connected Consumer Experience) are leading the way in monetizing vehicle data

• BMW CarData is live in Europe and creates platform for consumer to opt into data sharing offering for which more than 50 companies have registered to obtain individual VIN-specific vehicle data. BMW is making 79 parameters of vehicle data available for a price on a one-time or bulk basis depending on the application.

• GM charges fleet partners (Spireon, Telogis, Fleetmatics, Avis, Element, etc.) for access to vehicle APIs. These fleet operators can resell the data. GM also launched an in-vehicle e-commerce platform (v-commerce?) for convenience purchases and reservations to be made from the dashboard while driving. Presumably marketing partners such a Dunkin Donuts and Exxon Mobil will pay for the privilege of participating.

• Other OEMs with available, monetizable APIs include Ford Motor Company, PSA, Renault-Nissan.
BMW CARDATA, GM MARKETPLACE

BMW CARDATA.
NON-DISCRIMINATORY ACCESS FOR THIRD PARTIES.

EXEMPLARY THIRD PARTY.

Wash Where Parked™

REQUESTED CAR DATA.

SERVICE OFFERED TO THE BMW DRIVER.

GM launches Marketplace for in-car shopping and reservations
EMBEDDED CONNECTIONS ARE FOR CUSTOMER RETENTION

“One percent of customer retention is worth $700M.”
- Alicia Boler Davis
Executive Vice President
Global Manufacturing,
Manufacturing Engineering
and Labor Relations at
General Motors

It is 5-7x more expensive to acquire than it is to retain a customer.
- Capgemini analyst
HOW WE CONNECT WILL BE EASIER IF WE KNOW WHY

• Where will the TCU reside?
  • Head unit?
  • Separate box?

• Who will manage the carrier relationship?

• What will the basis of the carrier relationship be?
  • Subsidized?
  • Multiple carrier solution?
  • White SIM?
  • Add car to existing wireless plan?

• Who will manage telematics service providers?

• Who will manage/own the data?

• Are we moving toward a carrier-agnostic connectivity proposition?

• Can carriers use network slicing and other 5G innovations to compete?
AUTOMOTIVE MARKETPLACE CHANGES

Marketing, engineering, other departments must pay.

Medium-Term – retail model faces significant challenges

Long-Term – model becomes passenger-centric and operationally fleet-management-focused

Phase One: Internal data sharing – including dealers

Phase Two: Data sharing 1-to-1 with external third parties – i.e. insurance companies – deployment of data APIs

Phase Three: Aggregating and sharing of data across auto makers and reselling of data 1-to-many
DO WE HAVE TO SHARE?

• Multiple applications require shared/aggregated data including:
  • Audience measurement
  • Traffic and weather
  • Road hazard info
  • Automated driving, safety
  • Insurance (How are safety systems impacting underwriting and claims?)
  • Security

• The market leaders in vehicle data monetization are:
  • GM, BMW, PSA

• The market leaders in cross-OEM vehicle data aggregation are:
  • CCC, Drive Time Metrics, HERE
## DATA COLLECTION PARTNERS

<table>
<thead>
<tr>
<th>Company</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Airbiquity</td>
<td>Platform for managing collection of vehicle data. Has RFPs and RFQs with multiple OEMs for data management platform. No built-in analytics.</td>
</tr>
<tr>
<td>Bosch</td>
<td>Collecting vehicle sensor data (ultrasonic sensors) to find open parking spaces (Community Parking) on streets and transmit that data to cloud for redistribution. Trialing this with Mercedes-Benz.</td>
</tr>
<tr>
<td>Continental</td>
<td>Remote Vehicle Data platform provides range of services, including vehicle diagnostics, tracking, geofencing, shared access to vehicles, accident notifications, location-based services (POIs, dealers). User server-less architecture (AWS Lambda, i.e. only pay for compute time).</td>
</tr>
<tr>
<td>DataRPM</td>
<td>Worked with JLR on analytics for predictive maintenance. Focused on analytics for manufacturing.</td>
</tr>
<tr>
<td>DriveTime Metrics</td>
<td>Collecting audio listening data to generate revenue from recording/media industry. Shares revenue with OEMs. 50,000 cars on platform with domestic U.S. OEM.</td>
</tr>
<tr>
<td>Harman</td>
<td>Has Ignite platform for managing data collection, delivering cloud services and providing related analytics. Subaru using Ignite.</td>
</tr>
<tr>
<td>HERE</td>
<td>Collecting vehicle sensor data from Audi, BMW, and Daimler vehicles for Open Location Platform. Company has revenue sharing program for OEMs sending data to Open Location Platform.</td>
</tr>
</tbody>
</table>
## DATA COLLECTION PARTNERS

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<tr>
<td>IBM</td>
<td>Working with BMW for CarData platform. IBM Bluemix acting as Neutral Server in Europe. BMW able to collect data from 8.5 million vehicles. Worked with GM for OnStar Go.</td>
</tr>
<tr>
<td>Informatica</td>
<td>Provides its Data Management platform. Has positioned it as capable of serving different verticals. Has a focus on analysis of CRM data for automakers.</td>
</tr>
<tr>
<td>Otonomo</td>
<td>Working with BMW and Daimler. Has relationships with a total of 9 OEMs. Has 5M vehicles on platform as of year-end 2017.</td>
</tr>
<tr>
<td>LexisNexis</td>
<td>Data aggregation and monetization for UBI.</td>
</tr>
<tr>
<td>Teradata</td>
<td>Provides wide range of cloud, database, and analytics solutions as well as related consulting services. A number of OEMs use Teradata solutions, including Ford, GM, and Volvo.</td>
</tr>
<tr>
<td>Verisk</td>
<td>Offers solution called the Telematics Data Exchange. Collects usage-based insurance data from OEM cloud platforms via API. Sells anonymized UBI data to insurers and shares revenue with OEM partners. Current public partner is GM.</td>
</tr>
<tr>
<td>Wejo</td>
<td>Works with 12 OEMs, has 3.5 million vehicles on its platform.</td>
</tr>
</tbody>
</table>
ROBOTAXIFICATION OF THE AUTO INDUSTRY

25 of Nvidia’s 320 Drive PX partners are robotaxis

e-Palette Alliance will leverage Toyota’s Global Mobility Services Platform to develop advanced vehicle and related mobility services for business applications

e-Palette Concept Vehicle will be fully autonomous, battery-electric vehicle with open control interface to allow partner companies to install their own automated driving system

Alliance launch partners include Amazon, DiDi, Mazda, Pizza Hut and Uber

TWO PATHS TO AUTONOMY: CORRELATED TO LIDAR, CAMERAS
ROBOTAXIFICATION OF THE AUTO INDUSTRY

Nvidia-led, LiDAR emphasis, shared resource, pod-like form factor, Level 4-5

Intel-led, camera emphasis, owned vehicle, mass market form factor, Level 2-3
IMPACT: OWNERSHIP

*SOURCE: LMC Automotive
“On the basis of assumptions with respect to the active member population, it is estimated that carsharing has removed between 90,000 and 130,000 vehicles from the road (9-13 vehicles per carsharing vehicle, including shed and postponed car purchases) in North America to date.” – Martin, Shaheen, Lidicker

“Across London in 2016/17 car club members sold or disposed of around 26,400 cars.” – Carplus London report.
NEW USE CASES

• Shared cars also serving as ride hailing vehicles
• Campus, amenity, company cars
• Dealer loaner cars and concierge offerings
• Exposure of the vehicle-less to cars
• Gig-related applications – delivery and non-delivery services
• Public transportation resource
• On-demand access to vehicles
### TABLE 1  Circumstances of Joining Carsharing

<table>
<thead>
<tr>
<th>Circumstantial Category</th>
<th>Percent of Respondents Completing the Survey (N = 9,635)</th>
<th>Percent of Respondents in Final Data Set (N = 6,281)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1  Owned at least one car, but needed an additional car for greater flexibility,</td>
<td>9</td>
<td>8</td>
</tr>
<tr>
<td>and joined carsharing instead of acquiring an additional car.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2  I am in college, and I joined carsharing to gain access to a vehicle while in college.</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>3  Owned one car, but I joined carsharing and got rid of the car.</td>
<td>13</td>
<td>14</td>
</tr>
<tr>
<td>4  My household did not have a car, but joined carsharing to gain additional personal</td>
<td>43</td>
<td>51</td>
</tr>
<tr>
<td>freedom.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5  My household did not have a car, but changes in life required a car and I joined</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>carsharing instead.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6  My employer joined carsharing, and I joined through my employer.</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>7  A car of mine stopped working, and instead of replacing it I joined carsharing.</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>8  Owned more than one car. Got rid of at least one car and joined carsharing.</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>9  I live in an apartment building with a designated carsharing vehicle,</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>and I joined through its membership arrangement.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 I joined carsharing for reasons other than those listed above. Please explain:</td>
<td>9</td>
<td>7</td>
</tr>
</tbody>
</table>

Question: Please select the statement that best characterizes the circumstances under which you joined carsharing.

**Source:** Impact of Car Sharing on Household Vehicle Holdings – Martin, Shaheen, Lidicker
REACHING VEHICLE-LESS CUSTOMERS

Chart: car ownership before and after joining a car club

Source: Carplus Annual Survey of Car Clubs - London
Falling car ownership amongst members surveyed

The proportion of new members owning at least one car after joining has fallen since 2012/13.

Car clubs help to defer future car purchase by members

As shown in the table below, results from the 2016/17 survey indicate that car clubs continue to have an impact on the likelihood of purchasing a car. This also reflects the progressive move away from car ownership in the Capital (particularly amongst the under 30s) – increasingly people do not see car ownership as necessary or desirable.

<table>
<thead>
<tr>
<th>Year</th>
<th>Respondents (overall) for whom joining a car club has made it less likely that they will buy a car in the next few years</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012/13</td>
<td>66%</td>
</tr>
<tr>
<td>2013/14</td>
<td>61%</td>
</tr>
<tr>
<td>2014/15</td>
<td>62%</td>
</tr>
<tr>
<td>2015/16</td>
<td>51%</td>
</tr>
<tr>
<td>2016/17</td>
<td>50%</td>
</tr>
</tbody>
</table>
For current vehicle owners across all regions, utilization of ride sharing to supplement their vehicle ownership only made it more likely that they would purchase another personal vehicle within the next 5 years.

Exhibit 1.1: Likelihood of Purchasing Personal Vehicle within Next Five Years by Ridesharing Usage

Source: Ridesharing Frequency and Future Vehicle Purchase Intention of Current Vehicle Owners – Strategy Analytics
AUTOMATED DRIVING ITSELF IS A LONG-TERM PROPOSITION

Source: Strategy Analytics Autonomous Vehicles Service
Automotive Infotainment & Telematics