Connected Car Ecosystem

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Landscape Integration

- **Telematics and infotainment**
  - Telematics API
  - Vertical telematics application
  - OTA Remote car management
  - Connected Car Application Interfaces
    - Open source infotainment APIs
    - Third party infotainment Applications
    - Multiplayer MNO Billing

- **Vertical Application integration**
- **Mobile Network Operator**
  - Provide Cellular connectivity
  - Application Provider – Big Data, service layer, application API

- **IoT Application and Platform provider**
  - Customized IoT database for M2M billing
  - Machine learning, sensor data
  - Single point of integration with ALL CDPs for billing
  - OTA Device management capability
  - Descriptive, Predictive and Prescriptive Analytics
  - Mobility Solution
  - Vertical Application integration
  - Data intelligence and visualization
  - Enterprise IoT platform for future scalability

- **Automotive OEM**
  - Telematics and infotainment
  - Mobile Network Operator - Provide Cellular connectivity
  - Application Provider – Big Data, service layer, application API

- **Connected Car Application Interfaces**
  - Internet Access
  - Car health and diagnostics
  - Vehicle to vehicle (V2V) protocol
  - Remote diagnostics and firmware upgrade
  - Driving Analysis and UBI
  - Incidents Data
  - Remote diagnostics and firmware upgrade
  - Engine
  - Safety / ADAS
  - Wheels and Tires
  - Outside Sensors

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Monetize the future

- MNO and Automobile OEM can build Connected car IoT marketplace where third party vendors can integrate with platform to onboard vertical application.

- Autonomous vehicles (AVs) will represent the ultimate manifestation of Advanced Driver Assistance Systems (ADAS), marking the shift from driver-assisted functionality to fully autonomous vehicle operation.

- MNO and OEM can harness the customer data they already have deep data with the help of machine learning AI algorithm company can deep dive into customer needs, spending pattern, behaviour, fine tune offers and incentives, and dynamically adjust pricing to build loyalty.

Source: McKinsey & Company
Autonomous car will generate app. 5 gigabyte of data per second vs 1 gigabyte per second in connected car, near future technologies can not transfer thousands of gigabytes of data wirelessly in a second for massive volume, need advance in-car edge computer to determine real time incoming data from car sensors to make intelligent decision and act in real-time.

Data algorithm use for massive autonomous car data coming from LiDAR, Radar, Sonar, cameras, GPS, sensors can be utilize for safety, insurance, V2I, driving pattern, driver behaviour can be available for business opportunities.

Connected vehicle and autonomous car data usage have strong potential for revenue generation, cost reduction, safety, innovation way to use limited resources and security enhancement.

Car ecosystem players will heavily rely on data for future research, engineering innovation, improvement, warranty, insurance, AI, machine learning, customer loyalty, upsale ADAS value added services. data will be next oil to determine future growth.
Vehicle to Everything (V2X)

- It is a vehicular communication system that incorporates other more specific types of communication as V2I (Vehicle-to-Infrastructure), V2V (vehicle-to-vehicle), V2P (Vehicle-to-Pedestrian), V2D (vehicle-to-device)

- Key technology to enhance Advanced Driver Assistance Systems (ADAS):
  - Vehicular communications systems, navigation, traffic
  - Collision avoidance safety systems
  - Pedestrian protection systems, blind spot
  - Autopilot, intelligent speed adaptation, night vision

- Wi-Fi based 802.11p is a foundational protocol for V2X

- Cellular V2X
  - Building upon LTE Direct device-to-device design with enhancements for high speeds / high Doppler, high density, improved synchronization and low latency
Pivot entry point: Controller Area Network Bus (CAN bus), in-vehicle Wi-Fi, telematics, Bluetooth, Vehicle to infrastructure communication, Connected device platform (CDP), AM/FM radio, tire pressure monitor sensors (TPMS), smart home connected to vehicle in garage, OBD II device

Average next generation car will have 10 million lines of code execute on microprocessor based Electronics Control Units (ECU) pass through CAN. CAN was originally design to centralised communication, security and hacking was not part of design consideration.

CAN is network of different controller, which broadcast specific data from sensor, device authentication on CAN network is vulnerable to rogue device joining CAN bus, listen the controller and broadcast messages. With deep expertise in CAN architecture and microprocessor ECU and rogue device can intercept and interject messages to CAN broadcast messages.

CAN is not fully encapsulated encryption messaging architecture, with smart sniffer hardware hacker can sniff data in transit. OBD II port is easy target to attached device cable to external device and laptop.
**Executive Summary**

- Connected car may have telematics monitoring of vehicle with one operator and another business model infotainment with another operator. Multiple APN on same SIM.

- Multiple Telecom operators/partners may share same SIM (separate APN) for different billing may bill from the same SIM in different territories. Therefore IoT/M2M device manufactured in one country may be exported around the world and utilize different operators in different countries and split billing by service type. For instance a connected car manufactured in Europe constructed with an embedded SIM could utilize one persona for telematics and another one for Mobile Operator.

- This same vehicle could utilize an infotainment for provision of in-vehicle mobile broadband services providing video and audio entertainment billed through a different local operator. In this example the manufacturer of the vehicle may well pay for the engineering data, while the entertainment would be billed to the driver and owner of the vehicle.

- Consumer insatiable appetite for new technologies and being connected all-time, fostering innovation at core for connected car future.
Connected car split billing use case continued