Automotive OTA Updates and Data Collection Increasing Memory Demand

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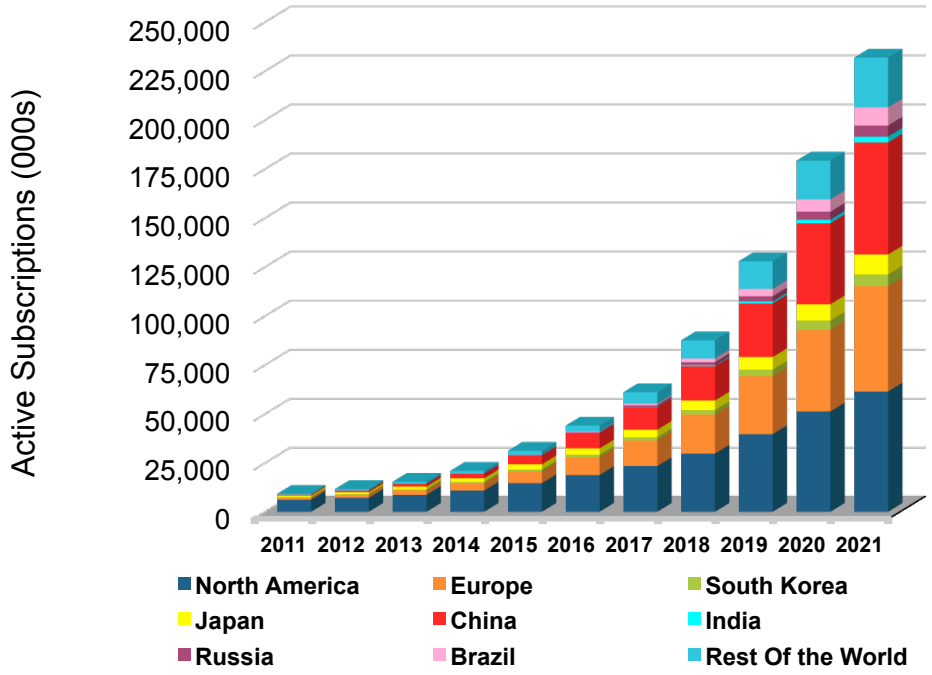
Automotive Connectivity

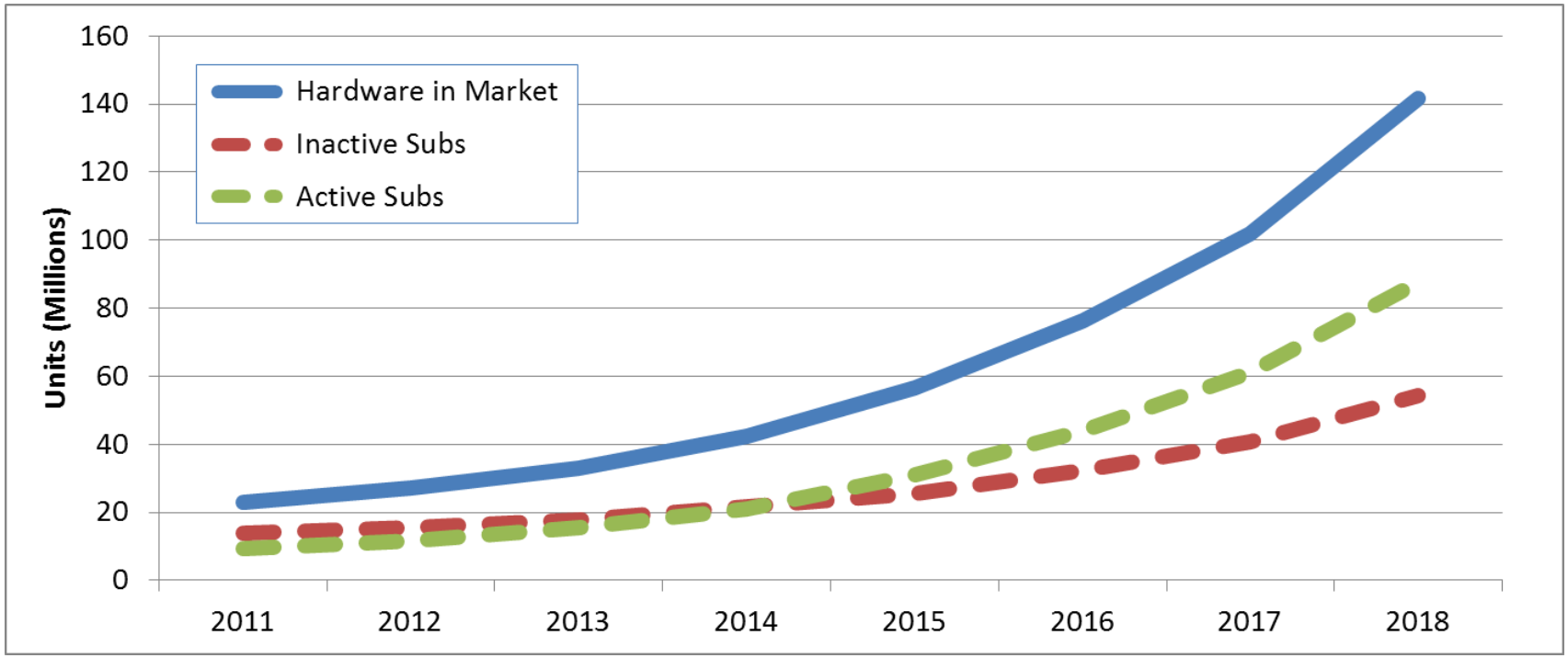
Global Active Subscriptions Will Exceed 250 Million by 2022



Leading Regions:

- **North America: Market Driver – U.S. is Single Market**
- **Europe: Market Driver – eCall**
- **China: Market Driver – Largest Global Car Market**

Hardware vs. Subscriptions

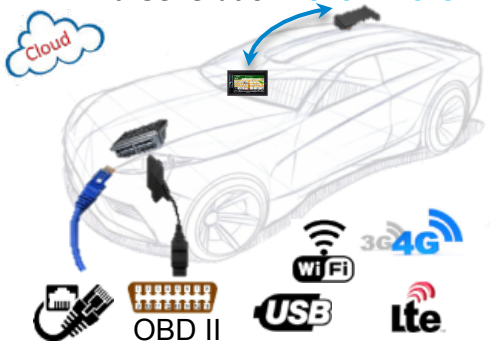


Automotive Software Updates

1st Generation 2000s

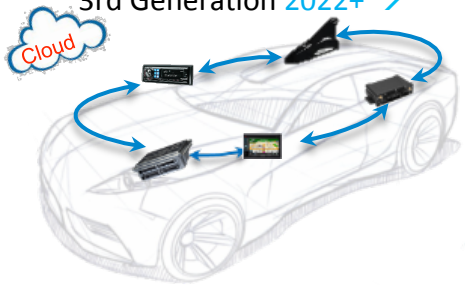
- No OTAs
- Limited to IVI
- High Friction for Consumer
- OBD II for ECU Flashing

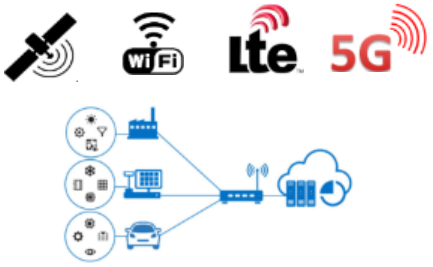
2nd Generation 2010→ 2019



- Limited OTA for TCU and IVI systems
- USB still mainly used
- Wired OBD II & Ethernet for Powertrain/Safety updates

3rd Generation 2022+ →





- Entire vehicle can be updated through multiple ECUs
- Vehicle fully part of IoT

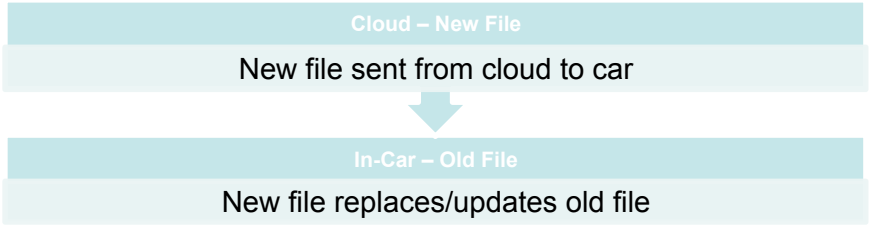
Source: Infotainment & Telematics Service

OTA Update Methods

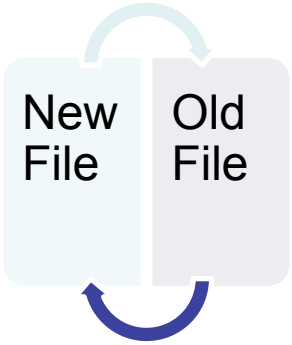
Two OTA update methods:

- **In-place update:** replace the current file with the new file
- **A/B update:** keep a copy of old file in memory until new file is successfully installed, then delete old file
- A/B requires **additional memory/storage** (i.e. space to store both files), which costs more, but offers fail-safe operation.
- **Implications:** Some ECUs **will require more memory/storage**, especially if they are safety critical.
- Automakers are looking **at a mixture of both approaches**.

In-place Update



A/B Update



Vehicle Data Collection

Driver data – Personal account information, personal contacts, payment information, driving behavior data, biometric data, personal preferences data (e.g. HVAC settings, seat position, audio source preferences, etc.), app/feature usage data, microphone data, in-cabin camera data, in-cabin sensor data (e.g. seat sensors)

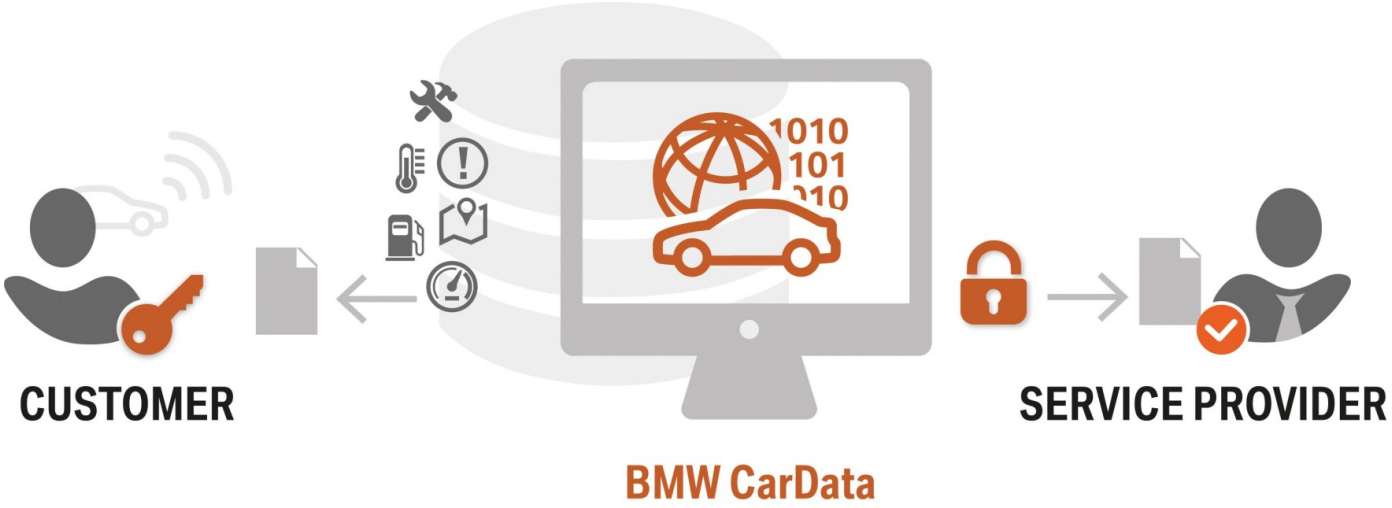
Vehicle data – inspection/regulatory data, collision/forensic (e.g. EDR) data, diagnostic/trouble code data (e.g. OBDII/ EOBD data), proprietary OEM data, sensor data, parts performance data, emissions data, vehicle security data (e.g. firmware/software security information)

Content data – media (music, video), content metadata (album art, station art, track/artist data), POI data, other types of data provided and/or owned by third parties

V2X data – Wireless network condition information, connected device information (e.g. smartphones, docked tablets) V2V data, IoT data (e.g. connections to smart home devices or EV charging stations), GNSS data, other satellite connectivity data, infrastructure data (e.g. toll ECU data)

Environmental data – Physical road conditions (e.g. ice, potholes), weather, traffic, road hazards/ furniture, outside temperature, available parking spaces

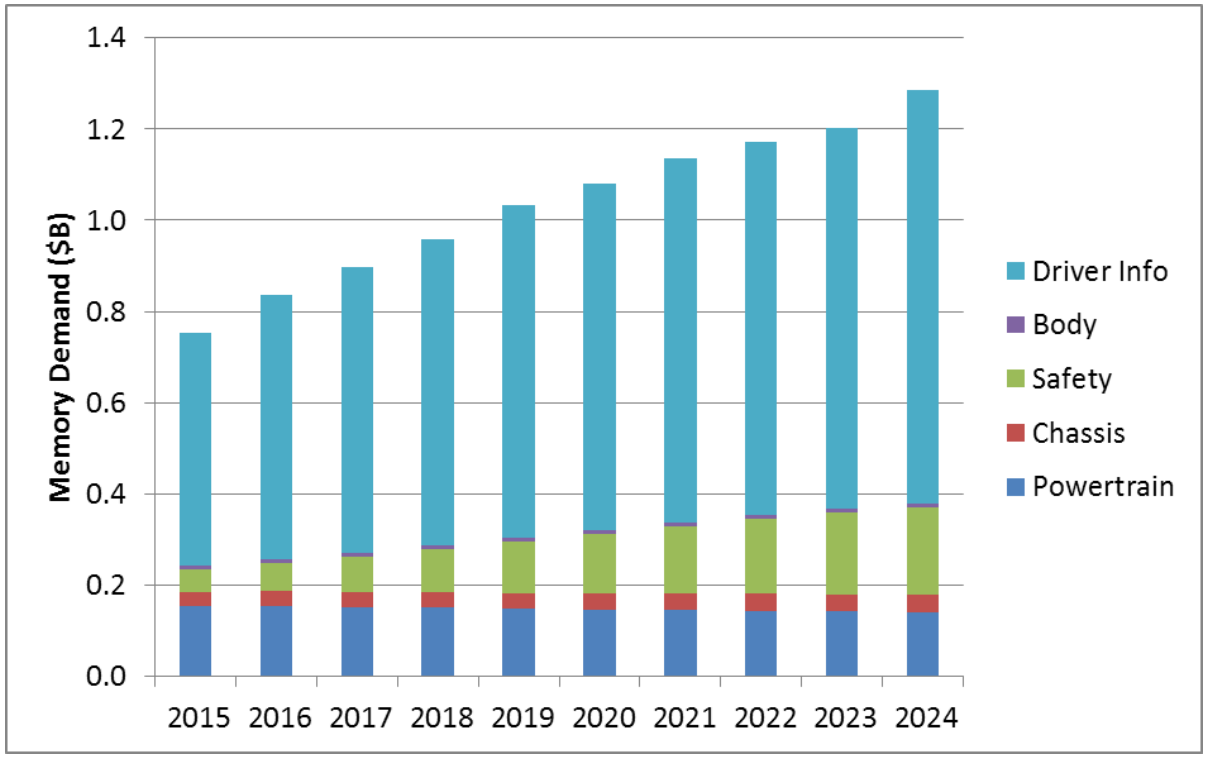
Automaker Data Collection Example



BMW launched its CarData platform on May 30, 2017, in Germany:

- Provides customers with access to their vehicle data when requested
- Complies with the EU's General Data Protection Regulation
- Provides a platform that gives third-party companies access to aggregated vehicle data

Revenue by Domain



- Driver information dominates, which includes infotainment and instrument cluster
- Fastest growth is in safety
- Safety CAGR = 18% from 2016-2021