GTC: Merging ADAS and Infotainment for Cloud Enhanced Safety

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Ford SYNC 1.0 - Past

Sync VR (1).avi
AIDAS - Future

AIDAS- A Conversational Agent for Supporting Information Access to Drivers.mp4
Trends

- Commoditization of hardware
- Differentiation on HMI, software, services, content
- Changing ownership models
- Market maturity – volume from developing world
- Infotainment + Safety in developed markets
- Safety + Device integration in developing markets
- Modularity? Upgradability?
- On-board commerce
- Gesture-based, multimodal interfaces
- Thought control – biometrics
- Driver monitoring
Fragmentation vs. Convergence

- Multiple OSes → Interoperability
- Multiple modules → Single vehicle gateway
- Multiple handset connectivity propositions → Proprietary platforms
- Multiple visions for monetization → CRM/Safety grounded value proposition with all-purpose e-com platform
  → okay, okay – an in-vehicle app store
Enabling Technologies

• Split-SIM, carrier-agnostic telecom modules

• Virtual machines in head units and on processors – instrument cluster, infotainment system, safety systems – one processor

• Firmware over the air updates

• Hardware upgradability?
Give the People What They Want

Safety vs. Infotainment
1200 consumers in US and 1200 in Western Europe rated importance of several factors in vehicle purchase.

Safety features ranked higher on average than infotainment in both US and Western Europe.
Consumer Interest in ADAS Compared to Connected Services (US)

- Both charts show % interested or very interested in feature.

- Interest in ADAS markedly higher than interest in connected services.
## Trend in Vehicle Segments and Sensors

<table>
<thead>
<tr>
<th>Assist Features</th>
<th>Full-size</th>
<th>Mid-size</th>
<th>Compact</th>
<th>Small</th>
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<tr>
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<tr>
<td>AEB (Low-Speed)</td>
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<td>✓</td>
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<tr>
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<tr>
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<tr>
<td>Bird Surround View</td>
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<tr>
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<tr>
<td>Auto High beam</td>
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<td></td>
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<tr>
<td>Dynamic lighting</td>
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<td>✓</td>
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</tr>
<tr>
<td>Night Vision</td>
<td>✓</td>
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</table>

### Sensors
- RADAR/Lidar/Camera
- Lidar/Camera
- Lidar/Radar
- Radar/Camera
- Ultrasonic / Camera
- Camera
- Camera
- Camera
- Camera
- Camera
- Camera
- Camera
- Camera
- Camera
- Camera/Bolometer
**ADAS Evolution Timeline**

**Technologies:**
- Radar
- Lidar
- Ultrasonic
- Camera: - Mono
  - Stereo
  - ToF
  - IR

**Ecus:**
- ACC
- Brake Assist
- Blind Spot
- Park Assist
- Lane Assist
- Pedestrian Det.
- Traffic Sign Rec.
- Auto High Beam
- Dynamic Lighting
- Bird/Surround View
- Night Vision

**Collision Mitigation**
- Sensor Fusion

**ADAS Domain Control**
- Highly Automated Driving Assistance based on fusion of comprehensive environment info

**Progression will be in incremental steps of automated assistance towards fully automated vehicles - e.g. emergency braking, automated parking ...............**
Cameras offer best combination of growth and volume. Previous use of IR sensors for LDWS is dying out. Ultrasonic sensors not included in above charts: there is still growth here, reaching over 235 million sensors by 2017.
Parking Applications
Largest for Automotive Cameras

• **100 million cameras** forecast to be fitted to light vehicles in 2020
• Parking cameras dominate camera demand. These applications typically have the lowest requirements for camera spec and processing power
• Total camera market less than the sum of applications due to multiple applications running on cameras
73 Million “Camera ECUs” in 2020

• Complex relationship between # of cameras and the # of ECUs required to control them & process data. Forecast impacted by # applications per camera, and level of integration / sensor fusion

• Almost half of ECU market in 2020 will remain for relatively low-end reversing cameras with limited processing.

• Mono front camera ECU next largest application – much higher value potential
NAFTA-produced Vehicles Driving Camera Demand

- Legislation such as Cameron Gulbransen Kids and Cars Transportation Safety Act helping drive **high penetration in NAFTA** – but these are mainly reversing cameras
- Japanese penetration did lead market due to high prevalence of navigation, and thus screens in cars, giving a display for the camera data
European Market Shows Highest Relative Prevalence of High-Value Applications

- Current **NCAP rules in Europe** forecast to drive adoption of cameras for forward-looking, high-value applications
- Adoption of similar rules elsewhere will drive camera forecast even higher
- NAFTA market looks very different – with reversing aids more dominant on current model assumptions.
• Cameras offer the best combination of volume and growth for all ADAS sensor types
  – Cameras are more flexible than other sensor types (e.g. RADARs). There are some applications that can ONLY effectively be done by cameras (e.g. LDWS, TSR). For other apps (e.g. autonomous braking) camera may be “good enough” for certain segments, and if already fitted to the vehicle is effectively a “free” sensor

• BUT significant part of camera market will be for low-value, low ECU-content parking applications
  – This market is the one most open at present to non-traditional safety vendors (e.g. head unit vendors, new semiconductor market entrants such as Nvidia & Qualcomm). Opportunities for these vendors to grow from these applications and take on more safety-critical applications
Camera Market Summary & Conclusions (2/2)

• Front mono camera to remain largest high-value camera/ECU application
  – Currently dominated by “traditional” automotive system & ECU suppliers, although often in partnership with relatively recent (in automotive terms) newcomer MobilEye
  – Many other semi vendors now aiming at MobilEye’s market share. Margins will be under threat. Lots of competition emerging for “ADAS Processor” chip, both from existing suppliers (e.g. Freescale, TI, Renesas) and new entrants (e.g. Nvidia, Qualcomm)

• NAFTA likely to be largest regional market for cameras – but with a high prevalence of reversing cameras (legislation driven)
  – Europe likely to be largest regional market for high-value forward-looking cameras (Euro NCAP rules)
  – Current forecast only assumes NCAP rules in Europe. Significant upside potential if similar rules brought in elsewhere
• “Building Blocks in Place” = vehicles with multiple cameras / RADARs / LIDARs / Comms technology etc.– but not fully autonomous under NHTSA level 4 definition
SOCA Tablet Head Unit
Architectural Concepts #5 – Vertical Display
OEM Display Deployment: Global Shipments by Position

- **OEM Display Growth Opportunity 2012 vs. 2020**
  - Center Multifunction: **+253%** (26.5 Mil in 2012 → 93.6 Mil in 2020) CAGR 17.1%
  - Driver Information: **+1015%** (6.6 Mil in 2012 → 74.1 Mil in 2020) CAGR 35.2%
  - Headrest: **+105%** (2.0 Million in 2012 to 4.2 Million in 2020) CAGR 9.3%
  - Center Roof mount: **+23%** (310K in 2012 to 390K in 2020) CAGR 2.7%

  → The Display becomes a key Human Machine Interface (HMI) point for: Audio, Media, HVAC, Telematics, Navigation, Social networking

  → The Display provides users with a flexible interface tool that will future proof vehicle systems

Source: Automotive Multimedia & Communications - AMCS
Global OEM Display Control: Touchscreen vs. Hardware Controller

- **OEM Display Controller Opportunity 2012 vs. 2020 (Global)**
  - Touchscreen shipments will expand at a CAGR rate of 23.9%:
    - 9.78 million units in 2012 to 54.4 million units in 2020
    - Touchscreen market share: 36% in 2012 → 56% in 2020
  - Hardware controller shipments will present a CAGR of just 11.7%:
    - 17.3 million units in 2012 to 42.2 million units in 2020
    - HW Controllers: Market share: 64% in 2012 → 44% in 2020

Source: Automotive Multimedia & Communications - AMCS
Firmware Over the Air Updates (FOTA)

Software/Firmware updates:

Thumb drive updates will go away and be replaced by updates via the embedded modem or via the customer’s phone.

- Issues here relate to file size. Tweddle is the sudden leader in smartphone FOTA and targets delivering 500K data packets for Toyota/Harman display-audio systems in Toyota vehicles.
- Typical app will require 4Mb-5Mb+.
- A file intended to add functionality to an ECU will be in the 50M+ range. Tesla, GM (Volt) and Mercedes Benz first to market with FOTA-equipped cars using an embedded modem. Toyota Entune uses smartphone connection for FOTA.
- Implications for consumer/dealer notification, security, software version management, dealer support.
- Toyota/Tweddle,
- GM-Chevy/Red Bend/QNX,
- Mercedes/Hughes/Mformation
OEM Telematics ECU
Cellular Modem Choice - Global

- Telematics ECU Modem forecast 2012 vs. 2020 (7.0 Mil. units → $41.3 Mil. units)
  - **2G Wireless Network**: 21K units in ‘12 to Zero units in ‘20 Units
  - **2.5G Wireless Network**: 6.25 Mil units to 0K units
  - **3G Wireless Network**: 660K units to 26.0 Mil units
  - **4G Wireless Network**: 50K units to 15.2 Mil units

Source: Automotive Multimedia & Communications - AMCS
Thank you!

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