HED®
Intelligent Vehicle Controls

Architecting Vehicle Systems

enabling adaptability, automation, performance and connectivity

Introduction

Chad Repp

Business Development Manager

CANect® Telematics | HED, Inc.

Chad manages the CANect® Telematics product family at HED, Inc. - working closely with internal and external customers to design, develop and implement best-in-class end-to-end Telematics solutions. Chad has over 20 years of asset mobility experience specifically in solution architecture and design and focused on Telematics and IoT.

Relevant Experience:

- 18 yrs. telecommunications
- 16 yrs. solution development
- 11 yrs. Telematics / IoT
- 6 yrs. product development

Milestones:

- Global wired/wireless network & cloud services for 5M= endpoints
- Private Network over cellular
- New technology Product releases

The Tesla Effect

Customer Satisfaction throughout vehicle life & ownership

- Highest customer satisfaction among auto manufacturers *Autoblog 2021*
- 91% repeat buyers *Car & Driver 2021*

Solving Challenges with Personality

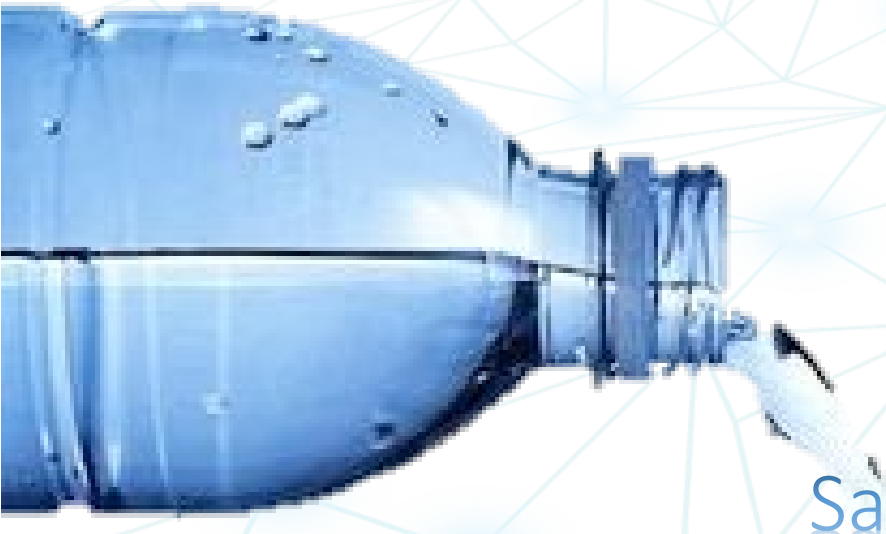
Range Anxiety

- ***Issue:*** *Limited charging station availability causes risk to long-distance drivers.*
- ***Solution:*** *Charging station buildout and improved navigation to support necessary charging stops.*

The "Me" Experience

- ***Issue:*** *Every driver has unique preferences beyond seat, peddle and mirror positions.*
- ***Solution:*** *User specific digital preferences/settings and continuous learning and updates.*

Driving Thirst for ~~Data~~



$AVINGS

Safety

Productivity

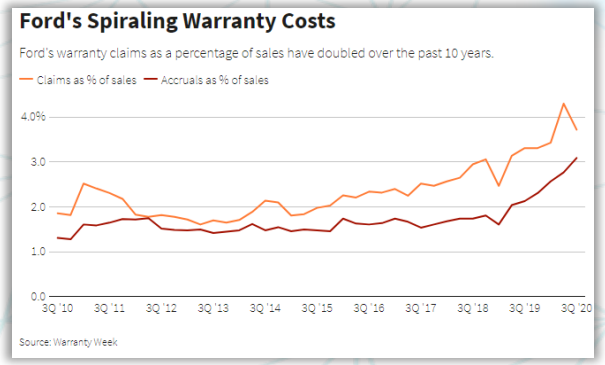
Improve uptime

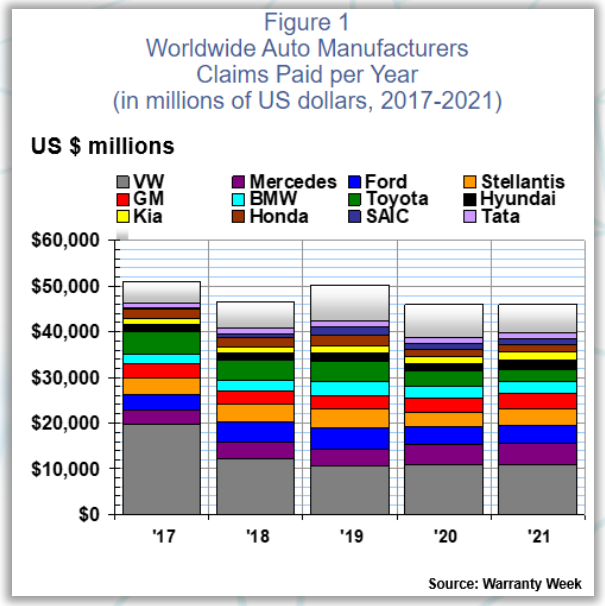
Predictive maintenance

Driver performance User experience

Over the Air Programming Efficiency Security

What about OEM $AVINGS





"Ford plans to use data gathered from vehicles to catch problems faster - in minutes rather than months in some cases - and fix them with over-the-air software updates" Jim Farley CEO Ford

Full System Updates Security

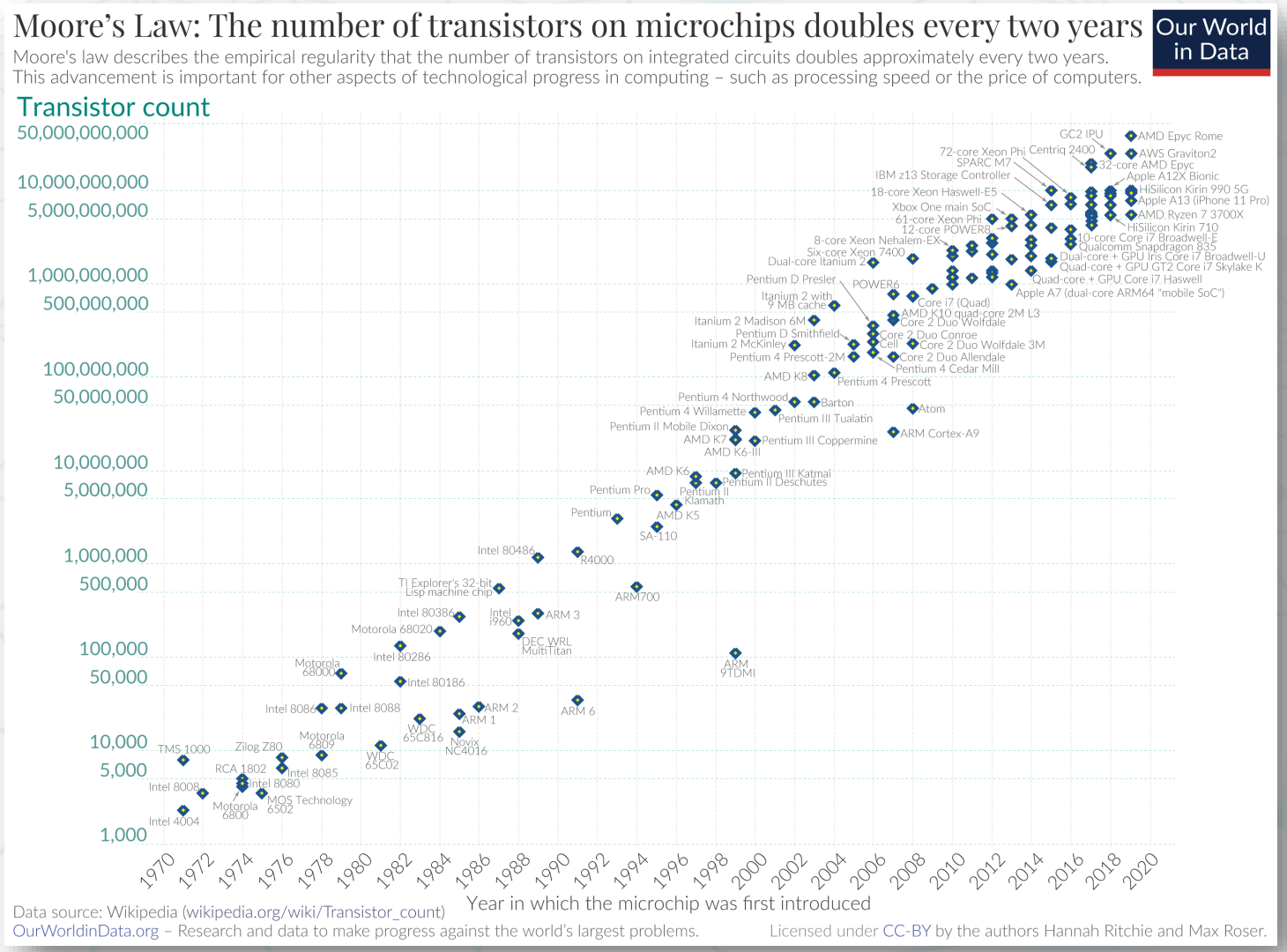
Warranty Claims R&D Field Data

Remote Troubleshooting & Repairs

The Growth of Data

Advancements in technology far outpaces society's ability to adapt.

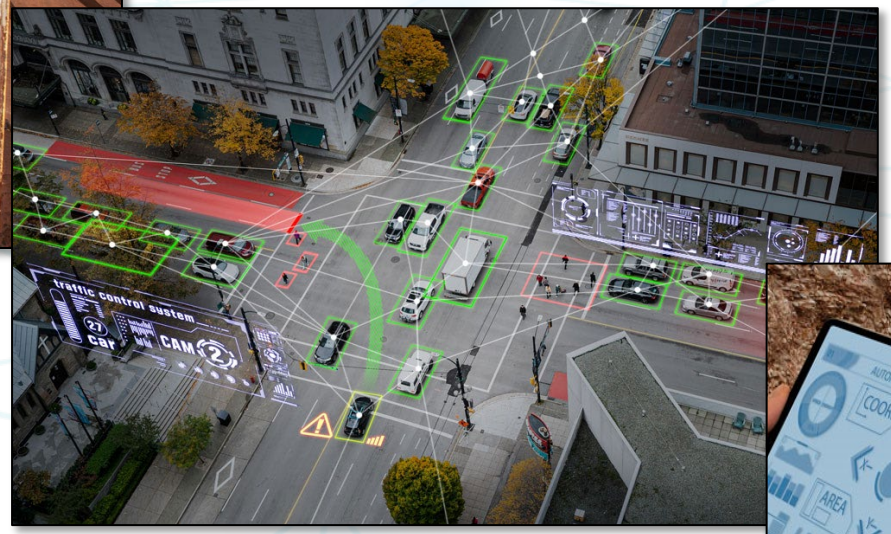
Thus, the driving force of change, technology, must be used to educate and train society on how to properly use the new technology in its most impactful and useful ways.



Technology Ramp

YESTERDAY

TODAY & TOMORROW



FUTURE

Application Driving Implementation

Application	Challenges / Concerns	Adoption	Wired	Wireless
Systems (Body, Chassis, Transmission, Engine)	QoS, Redundancy, Security	Full	CAN, Ethernet	Bluetooth
Accessories (Door Locks, Climate Control, Lighting, Mirrors)	Locations, Intelligence, Number of Connections	Full	LIN, CAN	Bluetooth / RF
Human Machine Interfaces (Displays, Keypads)	Increased amount of data consumed	Full	CAN, Ethernet	RF
Single Video / Infotainment	Throughput, Access, Security	Various	CAN, Ethernet	Cellular

Network Characteristics

	LIN	CAN	CAN-FD	Ethernet	Bluetooth	WiFi	Cellular
Security	○	○	◑	◕	◔	◕	◕
Data Rate	◔	◔	◑	●	◑	●	◕
Quality of Service (QoS)	◔	◔	◑	●	◑	●	◕
Connectivity Access (PnP)	○	○	○	◕	◔	◕	◑
Distance Supported	◔	◔	◔	◕	●	●	◕
Typical Applications	HVAC Lighting Wipers	Engine Brakes Trans	Same as CAN at higher volumes	Video HMI OTAP	Infotainment Lock/Unlock	Infotainment Hotspot OTAP	Telematics OTAP Video V2V

The Vehicle of the Future is Software

200x

the data of today by 2040

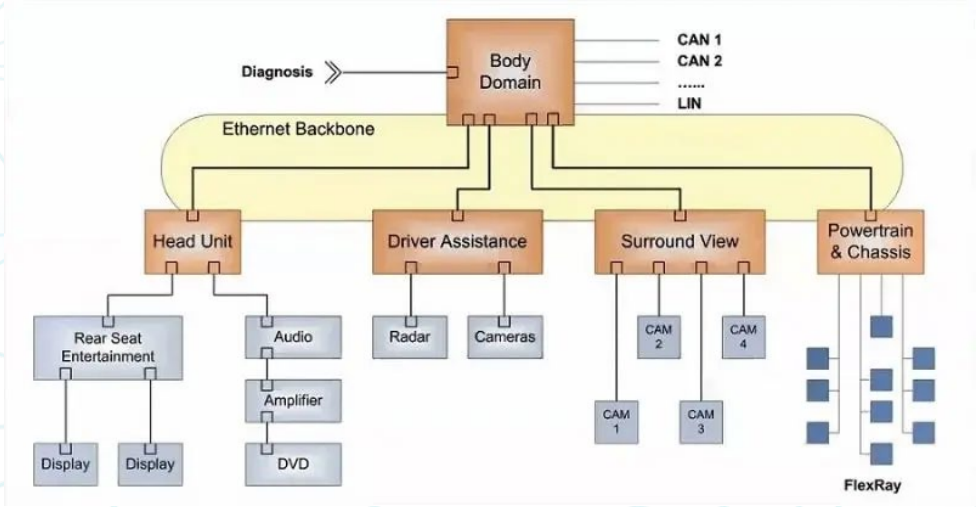
Future of Industrial Applications

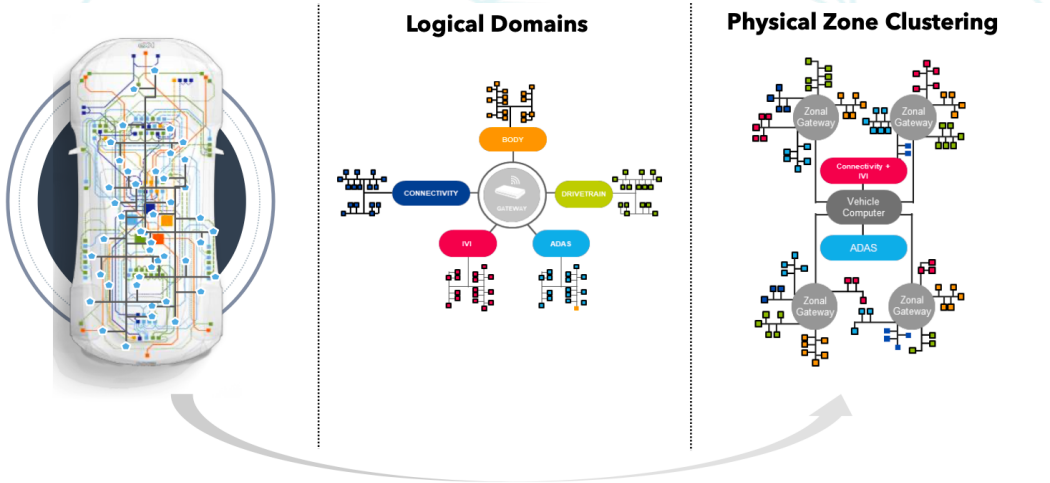
- **360 video**
  (trailer cam, side mirror video, etc.)
- **System/Process automation**
  (lane departure, adaptive cruise/braking, etc.)
- **Remote control**
- **Autonomous driving**
- **Alternative Fuel**
- **Access Controls**
- **Checklists**
  (maintenance, inspection, inventory)

The Future of Vehicle Architectures

The industry moves from a centralized backbone to a zonal architecture.

- Ethernet backbone to connect zonal CAN systems
- Processing pushed further to the edge at much higher data rates
- Telematics will require deeper vehicle integration for data access
- More data will mean more planning on what data is important





Where is….Your Data?

- **New Vehicle Technologies**
  (electrification, alternative fuel, driver assistance)
  - Manufacturer validation (Warranty, Support, R&D) – aggregated data across OEM
  - Customer acceptance / adoption – direct feedback in the moment and over time
- **Online vs Offline Functionality**
  - Connectivity is King, but not ALWAYS available
  - What vehicle functionality requires external connectivity? (access controls, navigation, etc.)
- **Cost of Transmission vs Cost of Computing**
  - $/MB is decreasing while volume of data is increasing
  - On module/vehicle computing is becoming more cost-effective method

Assets Defined by the Cloud

Telematics

- Condition based monitoring
- Maintenance and Prognostics
- Asset / Operator tracking
- Performance Management
- Improve Safety

Software Defined Vehicle

- Full System over-the-air-updates (new display graphics, improve controller functionality, collect new data points)
- New Feature release post vehicle build
- Feature-as-a-Service – Sell functionality as its needed rather than at time of asset purchase
  - Simplify production and procurement
  - Provide value as needed – “What works today, may not be what's needed tomorrow”

Key Takeaways

1. **Application driven**
   Topology, protocol, computing, storage & component definition should be done based on application needs.
2. **View costs holistically**
   Low cost in one component, may cause incremental costs in another area.
3. **Segmentation is critical**
   Security, networking costs, processing, and data availability.
4. **Design with future in mind**
   Balance today & tomorrow by keeping future needs in mind while not overbuilding for everything.
5. **On vs. off vehicle processing**
   Determine processing based on latency, accuracy and cost needs.

Questions?

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