Is The Connected Car Really A Major Business Opportunity?
Are We Flushing Money Away Having No Convincing Customer Benefits?
Or Is It True That Services / Content Are Aligning With Customer Needs?
A Lot Of Questions Remain Open ...

**DEMAND**
- Consumers’ unwillingness to pay – hardware cost and subscription cost
- Closed system locking content and service provider choice
- Inability to port consumer electronics experience to the car environment
- Lack of killer applications
- Privacy issues

**SUPPLY**
- Cost of service mostly exceeding revenue
- No convincing business model
- Reluctance of telcos to engage
- OEMs trend to reduce electronic content
- Question as to whether telematics is a source of competitive advantage
- Can we control the vehicle architecture?
Anyway It Goes, Car Electronics Will Grow Driven By Safety & Comfort

NB: Bubble size proportional to 2008 projected revenue
Source: Strategy Analytics, Magna, CTA Consulting Analysis
As Much As 40% Of The Car Content Will Be EE Within 5 Years

An increase of $50B in EE systems between 2004 and 2010

Changes between 2005 and 2015:
- Market growth: 6.5% CAAGR
- EE systems content: from $2,500 to $4,800

Proportion of vehicle content

Source: Mercer
Sample Connected Cars Features: Consumer wants v. Penetration

- Adaptive Cruise Control: Demand 63%, Supply 1%
- Tire pressure Monitoring: Demand 79%, Supply 13%
- Satellite Radio: Demand 44%, Supply 7%
- Stability Control: Demand 75%, Supply 11%
- Navigation Systems: Demand 62%, Supply 3%

Gap = Opportunity

Source: JD Power Survey
Are We Heading Towards A Major Crisis In Vehicle Electronics?
Electronic Integration: The bitter sweet!

OEMs: Limit integration for components scale benefit & increase competition

Suppliers: Upintegrate to increase content & drive cost down

Source: Booz Allen Hamilton, CTA Consulting
User Interface: Is The Consumer Bound For Pilot Training?
Dealing With Complexity = Redefine Architecture - Particularly Communication

Automotive EE Value Chain: Roles & responsibilities

EE Systems Value Chain

Vehicle System Design & Integration
  - Vehicle Manufacturer
  - Architecture suppliers / wiring suppliers

Functional System Design & Integration (Autosar)
  - System suppliers
  - System engineering houses
  - Engineering Services
  - Architecture design
  - System integration & validation

Components Design (ECUs)
  - Traditional automotive component suppliers
  - EMS
  - Component design & manufacture
  - Operating System

Silicon
  - Processors suppliers
  - µ-processors / ASICs / µp design
  - Fabs / micro-machining

Who?

Value-add?

Architecture design complexity induced by feature richness and integration requirements

Growing number of “multi-purpose” up-integrated ECUs with ever growing feature content
A New Architecture Paradigm Is Needed

- Standardize for flexibility & scale
- Partition & integrate
- Leverage communication technologies
- Think lifecycle management
- Implement a holistic Vehicle Communication
Shift The Proprietary Approach Paradigm To Open Standard Architecture

- Holistic approach
- Open Hardware Architecture with standardized internal interfaces
- Open Software Architecture with standardized APIs
- Customer value-add focused
- Forward looking
- Recognizing differences between vehicle-centric and consumer-centric functions
Partition Features Along Vehicle-centric & Customer-centric Features

**Entertainment**
- Audio
- Video
- Games
- Internet access

**Information**
- Information channels access
- Parking information
- Stock market
- Flight information

**Mobility**
- Emergency call
- Real time traffic information
- Automated routing
- Remote unlock
- LBS / Point Of Interest information

**Productivity**
- E-mail access
- PDA synchronization
- Virtual assistant

**CRM**
- Car owner identification (at dealer)
- Pattern of use tracking
- Personalized communication
- Theft control

**VRM**
- Remote diagnostics & maintenance
- Software downloads
- Real time warranty information access

**Safety**
- Emergency calls
- Remote distance warning / traffic signals recognition
- Lane departure warning
- Adaptive cruise control

**Consumer-centric**
- Machine to Human
- HMI focus
- Consumer value-add

**Vehicle-centric**
- Machine to Machine
- Back-end processes integration
- Service improvement
Communication Technologies

Network Characteristics
(Effective Bandwidth, Coverage, Cost)

X
Mission Requirements
= Communication choice

- Effective Bandwidth
- Mission Requirements
- RTT
- Location

In-Vehicle
Local
Wide

10m
50m

1Mb/sec

Diagnostic & Data
Software Downloads

CAN
WLAN, 802.11x
MOST
Wired

Flex Ray

Bluetooth
WUSB
Zigbee
700-900 MHz

EDGE
GPRS
GSM, CDMA

Satellite: LEO, Galileo, GPS, etc.

Off-board Navigation
Accident/Traffic Data
**Current state:**
- Chipset based embedded equipment supports single communication technology for life of product

**Challenge:**
- Many foreseen and unforeseen development directions (E.g. possibility of satellite-based GSM to provide coverage in rural areas, Wimax, 5.9 GHz WAVE)

**Future state:**
- Implement a fully updatable software-based communication module
- Integrate into other vehicle electronics (e.g., navigation product, head unit) and connected to the in-vehicle network
- Software controlled antenna controlled by software filters, providing the ability (within reason) to accommodate changes in frequency across the primary communications bands
Implement an Architecture for Vehicle Communication Management

- Wi-Fi
- SDARS
- Gateway Processor
- GPS
- Bluetooth
- GSM/GPRS or CDMA/1x
- Power Supply
- System Memory

- Head Unit
- Remote Buttons
- Audio In / Out
- Vehicle Messages (airbag, diagnostics, …)
- Vehicle Network (MOST / CAN)
Changing The Paradigm = Getting Focused On Consumer Value-add

• Automotive electronics complexity creep will not subside
  – Safety: functions for which consumers are ready to pay
  – Entertainment: Digital lifestyle ubiquity
• The historical proprietary architecture approach is a hurdle to handle the increasing electronics complexity
• We need to change paradigm & streamline the car communication architecture
  – Standardize mechanisms for flexibility
  – Partition
  – Leverage communication technologies
  – Think life cycle management
  – Implement gateway
• Once done, the industry will be able to focus on consumer value-add rather than the never ending integration challenges