ALEX HESLOP
DIRECTOR-ELECTRICAL ENGINEERING

ANDY GRIFFITHS
CHIEF ENGINEER-SOFTWARE AND SYSTEM INTEGRATION AND TEST

ENABLING THE SOFTWARE FACTORY
CHALLENGES FOUND, FIXED AND NEED FIXING
1948 PIONEERING, DISRUPTIVE SPIRIT, STRONGER THAN EVER
DEFENDER BREADTH OF APPEAL

POWERFUL

URBAN CHIC

CLASSLESS

HEROIC

ADVENTUROUS

DEPENDABLE

STRONG

BRAND DEFINING

CAPABLE

WORKHORSE

SHIP OF THE DESERT

LIFE ENHANCING

ONE OF THE FAMILY

ADAPTABLE

TIMELESS & ICONIC
MISSION: REIMAGINE THE ICON, OBSESSION FOR THE PHYSICALS

PURITY

AUTHENTIC

FUN
TESTED TO THE EXTREME

DYNAMIC ROOF LOAD 168KG

WADES OVER 900MM DEEP

CONQUERS GRADIENTS UP TO 45-DEGREES

ELECTRIFIED:

MHEV & PHEV OPTIONS

WIDEST CAPABILITY ENVELOPE

OFF-ROAD CAPABILITY
ON-ROAD CAPABILITY
CONNECTED CAPABILITY
ENGINEERING THE TRANSFORMATION OF CONNECTED CAPABILITY
CONNECTED CAPABILITY:
NEXT GENERATION ELECTRICAL ARCHITECTURE

BRAND NEW ELECTRICAL ARCHITECTURE:
CENTRALISED COMPUTE
100MB ETHERNET BACKBONE
21,000 MESSAGES
MULTI-LAYERED CYBER SECURITY
ULTRA-WIDE BAND ANTI-THEFT SYSTEM

ALWAYS ON
ALWAYS CONNECTED
AWAYS UPTO DATE
CONNECTED CAPABILITY: PIVI - HMI DOMAIN CONTROLLER

QNX OPERATING SYSTEM
SMARTPHONE-LIKE HMI

SCREEN:
INTUITIVE, SIMPLE, CUSTOMISABLE

CONNECTIVITY:
APPLE CARPLAY,
ANDROID AUTO,
BAIDU LIFE

CHALLENGES:
- HMI VALIDATION
CONNECTED CAPABILITY: ADAS

AUTOMATED PROGRESS & ACTIVE SAFETY

SENSE: 3-RADAR & SYSTEM-ON-CHIP CAMERA
PLAN: 6-CORE DOMAIN CONTROLLER
FUSES RADAR & CAMERA DATA
ACT: VEHICLE MOTION CONTROLLER: BRAKE-STEER-ACCELERATE

LOW SPEED MANOUVREING & GUIDANCE

4X HD CAMERAS, 190° FOV
3 GB/S VIDEO BACKBONE
POWERFUL GPU

CHALLENGES:
- END to END TRACEABILITY
- SCENARIO COMPLEXITY
CONNECTED CAPABILITY: CONNECTIVITY DOMAIN CONTROLLER & SOFTWARE OVER THE AIR

QNX OPERATING SYSTEM
COHERENSE© SERVICE ORIENTATION

14 VEHICLE MODULES
DUAL BANKING
DIGITAL TWIN: ALWAYS UP TO DATE
ENCRYPTED SOFTWARE

USES EMBEDDED PRE-PAID SIM

CHALLENGES:
- INTER-PROCESSOR COMMS
- HYPERVISOR COMPLEXITY
As complexity increases we need to adopt innovative new ways to integrate and test.

Domain based Electrical Architecture shifts focus from monitoring Network Comms to inter-process comms.

Effective tools integration is key to managing the end to end value stream.

We need to manage and react to weekly incremental change.
ENABLING THE SOFTWARE FACTORY – OUR APPROACH
Structured system decomposition and layered test

Decomposition enables understanding of complex systems and full traceability
ENABLING THE SOFTWARE FACTORY – OUR APPROACH

Enabling flow and early feedback

Through an iterative approach we can enable early learning and refinement
ENABLING THE SOFTWARE FACTORY – OUR APPROACH
Managing increasing complexity through evolution & re-use

THE PAST (Multiple Production Branches)

TODAY (Single Mainline Approach)

By enforcing a single mainline approach and driving re-use complexity can be managed
ENABLING THE SOFTWARE FACTORY – OUR APPROACH
Using scalable automation to ensure validation is not the bottleneck

Value Flow: Feature, Fixes, Risk Reduction

- Software Commit
  - Automated Build & Update
    - Test Execution SW In Loop
      - OTA Data Collection
        - Data Process & Result Analysis
          - Automated Build and Update
    - Test Execution HW In Loop
      - OTA Data Collection
        - Data Process & Result Analysis
          - Automated Build and Update
- Development Teams
  - Automated Build and Update
  - Test Execution Vehicle In Loop
    - OTA Data Collection
      - Data Process & Result Analysis
        - Automated Build and Update
        - Vehicle User Test
  - OTA Data Collection
    - Data Process & Result Analysis
      - Automated Build and Update
        - Vehicle User Test

Fast Feedback

Virtualised test and automated execution and data analysis enabling increased factory throughput
ENABLING THE SOFTWARE FACTORY – OUR APPROACH
Maximising the value of the testing

1. Diagnostic Trouble Code
   - Snapshots taken daily and trouble codes and DIDs analysis by engineering teams

2. ECU Resource
   - RIGS and vehicle ECUs probed for memory CPU and internal COMMS profiles

3. ECU Performance
   - Timing & power performance monitoring through end to end and log signatures

4. ECU Stability
   - Monitoring ECU stability through external and internal log signature

5. Network Load
   - Ongoing monitoring of traffic across the whole vehicle network

6. Requirement Coverage
   - Confirming all key requirements have been met and tracking regression

7. Feature Stability
   - Ongoing real life stress test of key function to build confidence in stability

8. Customer Usage
   - Collecting data from fleet vehicles on customer usage & vehicle health

Every feature tested, every ECU monitored, dynamic testing based on continuous feedback
ENABLING THE SOFTWARE FACTORY – OUR APPROACH
Dealing with the vast increase in data collected

Through continuous data collection and analytics we can improve our design, integration and test
Through our strategic partnerships how do we collaborate better to deliver more:

**PRODUCTIVITY**: using automation to deploy more features & fixes every day

**RELIABILITY**: focus on fixing product over platform setup issues

**FLEXIBILITY**: simple to use modular test platforms for changing requirements

**TRACEABILITY**: minimise overheads linking requirement with test cases

**ENABLING THE SOFTWARE FACTORY – FUTURE CHALLENGES**

Single goal to **Create, Integrate & Release** new product every day

Through collaboration we can compete the age of software