

proteanTecs and Dell Technologies

Electronics health and performance monitoring to ensure system reliability and safety through a product's lifecycle using Dell Technologies products.

Ensuring reliability and safety of electronics

Reliability and safety are crucial features of modern automotive platforms, and semiconductor chips used in these architectures must comply with the applicable requirements mandated by the automotive industry, which includes ISO 26262. The functional safety requirements described in the ISO 26262 standard includes defining the goal of preventing any risk of harm for drivers and road users caused by malfunction of electronics in vehicles.

Despite best engineering efforts and practices, random hardware failures that appear during the lifetime of a system are inevitable in advanced electronics. This is due to defects innate to the manufacturing processes or caused by operational conditions, overstress, and usage as well as normal material degradation and aging. Automotive applications, in particular, are of concern as chip failures can be catastrophic if they impact vehicle safety.

Challenges increase as technologies advance



Stronger impact of degradation & failure mechanisms

- Bias Temperature Instability (BTI)
- Hot Carrier Injection (HCI)
- Time Dependent Dielectric
- Breakdown (TDDB)
- Stress-Migration (SM)
- Electro-Migration (EM)
- Over Time



SW impact on HW

- Dynamic mission profile
- AI/ML driven applications



Advanced SoC and SIP Packages

- 2.5/3D Packaging
- Micro-bump cracks and voids
- Bridge-shorts on package substrates
- Silicon die warpage



Increased thermal density

- High performance applications
- Higher transistor density
- End of voltage scaling



Latent defects

- Increasing design complexity
- Advanced process technologies
- Limited visibility

Keeping growing complexity in check

Electronics have reached an unprecedented level of complexity and performance but typically lacks the ability to monitor and assess their own health condition and reliability level. Latent or marginal defects from production make their way into the field as “walking wounded” devices. On top of that, as a product ages, performance margins shrink, exposing the system to further and even more dominant failure mechanisms. Constant over-the-air (OTA) updates and application loads overstress the electronics. Over time there is an absolute need to constantly track, predict, and adjust the operating parameters of the electronics to ensure the highest level of reliability.

Advanced electronics can be monitored today - for example, by using limited telemetry and data-driven ML based approaches that allow failures to be predicted ahead of time. Such approaches, however, are limited by the breadth and depth of data available. Often these limitations restrict the solution to reactive predictions with brute-force outcomes, such as forcing the monitored electronics, and thus the vehicle itself, off-line and/or into test mode (limp-mode). Further, what data is available must be captured and transferred from each vehicle to the OEM wherein it is then analyzed before any failure predictions can be made. Hence though automotive manufacturers can theoretically detect many field failures and resolve issues before they manifest into a catastrophic failure, today's solutions are inherently limited and slow to respond. As vehicles move towards electrification and autonomy, today's solutions are simply not good enough to handle the growing complexity.

Companies need an in-situ solution that self-diagnoses issues at the ECU and chip level, in real-time – long before failures would manifest to the level that today’s systems would detect them.

Deep data analytics

Dell Technologies has recognized the industry need for more robust predictive failure solutions for ADAS/AD and has joined forces with proteanTecs to ensure safety at the highest possible level where it matters most: on the road.

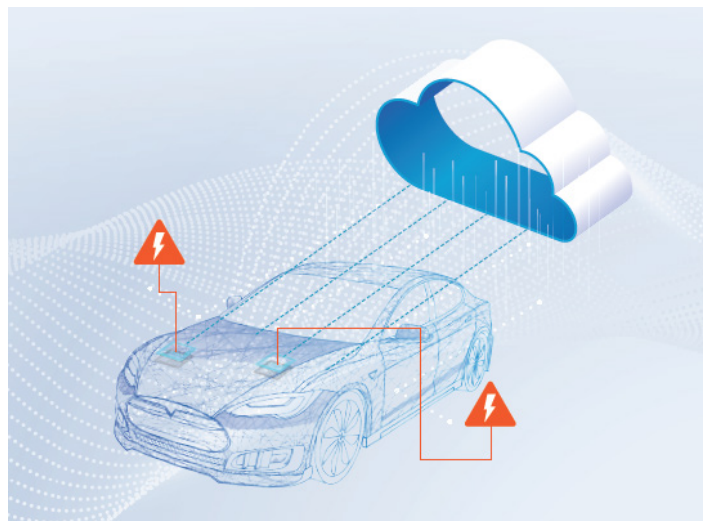
An inward approach to Predictive Failure

proteanTecs ensures the highest level of visibility into the operating validity of the equipment by empowering each chip to self-diagnose with AI. At the first level, a set of agents embedded within each chip runs constantly to check the health and operating conditions, generating high resolution and parametric deep data. The data collected by these monitors, during production and while deployed in the field, is then subject to machine learning to build an accurate map of potential risks and alerts. Once deployed, these algorithms can predict failures long before they even happen and alert the end-user well in advance such that proactive steps can be made. A combination of machine learning and deep data analytics both at the car level as well as the fleet level enhances the capability to predict, monitor and act upon any kind of event or set of events in a holistic manner.

proteanTecs ensures the ability to inspect the inner behavior of the electronics for remote diagnostics, continuous performance monitoring, degradation monitoring and quick debug of issues without the need to physically access the device. It not only ensures safety and reliability of the car and in the electronics system running it, but OEMs as well as fleet managers can also benefit from increased availability of the products while extending system lifetime.

proteanTecs Benefits

- Supports ISO 26262 safety standard compliance
- Towards-zero DPPM and avoidance of random hardware failures
- Increased hardware reliability and availability
- Monitoring of SW effects on HW
- Pinpoint root cause analysis with fast time-to-resolution
- Optimal maintenance and serviceability, by predictive and prescriptive maintenance



proteanTecs health and performance monitoring of electronics

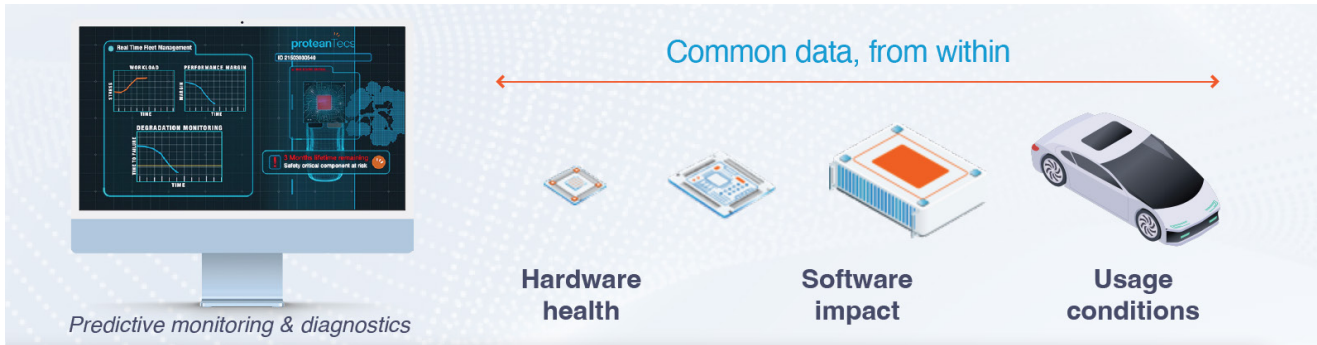
A new paradigm shift: Monitoring SW impact on HW reliability.

Software of any kind is run on the hardware product constantly. Whether it is firmware running on the ECU unit or an ADAS/AD application running on a CPU or GPU compute grid, it imposes stress to the hardware – akin to how stepping on the

accelerator of a car imposes wear on an engine. In some cases, the stress on the hardware requires operating conditions to be altered in order to maximize performance while keeping reliability at the same level.

proteanTecs enables workload monitoring that can detect the level of stress imposed on the system by the software, identify changes in the load between different versions of SW, or as a result of a change in operation load. Thus, the system can be adjusted in accordance with the workload requirements. For example, finding the perfect balance between workload and margins and fine tuning of voltage and frequency for the specific condition can be set in order to maintain a balance between reliability, performance and power consumption. This could be done by FW or HW depending on the type of reaction needed and the car manufacturer preferences. A closed loop mechanism that constantly tunes operational conditions to ensure adequate margins for every workload while minimizing power and heat generation.

Since the CPU is the heart of the ECU and thus is exposed to power distribution and thermal conditions inside the ECU it becomes effectively the most accurate sensor to all its surroundings.

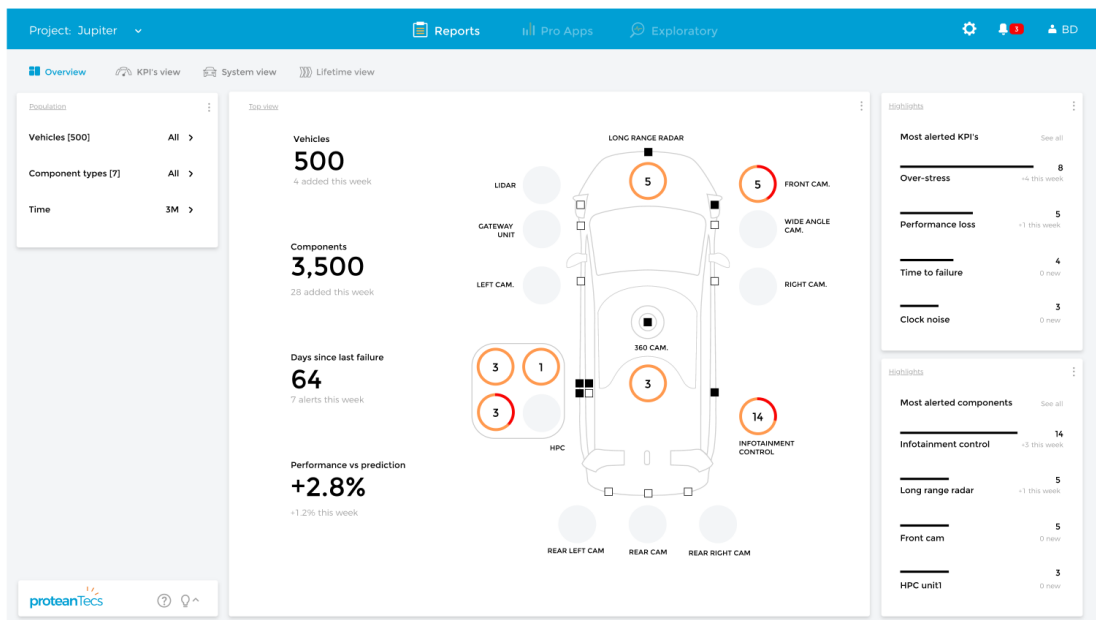


proteanTecs deep data monitoring throughout production and lifetime operation

A new level of fleet management

For fleet operators, proteanTecs deep data analytics solution collects valuable data from each vehicle and turns them into an insightful knowledge base that serves the entire operation.

A set of conditions and remaining operating margins is collected from enhanced telemetry and the real time apps that analyses them throughout the entire fleet and insights are derived in a way that any failure precondition now is identified.



Whether it is a faulty electronics device or an overstressing software upgrade, their effect on the system reliability is closely tracked and compared with previous data collected.

This enables quick and accurate root cause analysis for every event which can be correlated in a fleet level to similar events enabling the creation of a knowledge base and thus supporting meaningful operational decisions to be made, maximizing the reliability and useful lifetime of the product and meet the mission profile while keeping safety intact.

A novel approach to predictive failure

proteanTecs enhanced telemetry is ubiquitous and accurate and therefore enables the prediction of error conditions long before they even occur. This changes completely the way maintenance is done on the electronics allowing for an optimized, predictive maintenance cycle that is based on smart rules and machine learning triggers, rather than on pre-scheduled and time-based preventive maintenance. A quick root cause analysis allows for the selection of the optimal service to be automatically scheduled far in advance of any error manifestation in the field. It also allows for supply chain optimization based on usage data from the field. Ultimately, advanced failure predictions lower warranty costs, improves buyer perception of quality and of course, reduces accidents caused by vehicle safety component failures.

proteanTecs offers advanced deep data solutions ranging from cloud analytics and on-board diagnostics to in-chip real-time applications.

About Dell Technologies

Dell Technologies helps automotive companies pursue new data-driven business opportunities in the software-defined era with future-proof infrastructure built on massively scalable, high-performance storage systems, intelligent servers, access to your choice of public cloud services, a streaming data platform, and a well-vetted ecosystem of software partners. We can support both traditional workflows and data-intensive, emerging AI workflows. Dell Technologies solutions offer simplified data management and predictable performance all at the massive scale required for ADAS and AD development and testing. Learn more about Dell Technologies storage solutions for Automotive Applications at DellTechnologies.com/Automotive.

About proteanTecs

proteanTecs is a leading provider of deep data monitoring solutions for advanced electronics in the Datacenter, Automotive, Communications, and Mobile markets. The company provides system health and performance monitoring, from production to the field. By applying machine learning to novel data created by on-chip agents, the company's analytics solutions deliver predictive insights and visibility, leading to new levels of quality, reliability, and safety. Founded in 2017, the company is headquartered in Israel with offices in the U.S., India, and Taiwan. For more information, visit www.proteanTecs.com

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