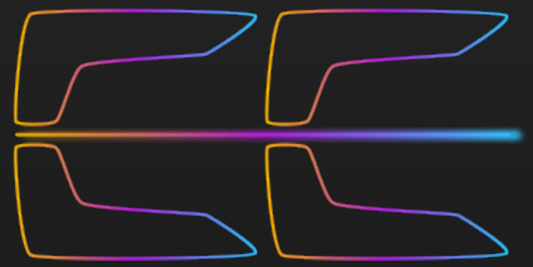
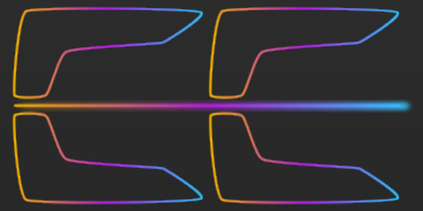


Automotive Electronics

VDK EE

Ford CEO, Jim Farley, 2023



Ford CEO Jim Farley was rather blunt about the problems that Ford experienced as it rolled out its hot EV models, the Mustang Mach-E and the F-150 Lightning pickup. While both vehicles have a long list of waiting customers, Farley admitted that Ford encountered numerous problems with their production.

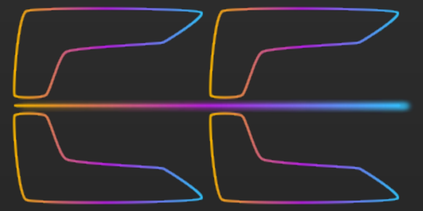
“We didn’t know that our wiring harness for Mach-E was 1.6 kilometers longer than it needed to be. We didn’t know it’s 70 pounds heavier and that that’s [cost an extra] $300 a battery,” he said on a call with investors. “We didn’t know that we underinvested in braking technology to save on the battery size.”

Farley said these and other cost problems meant that Ford “left about $2 billion of profit on the table.”

CNN - Sat February 4, 2023

VDK EE

Ford CEO, Jim Farley, 2023

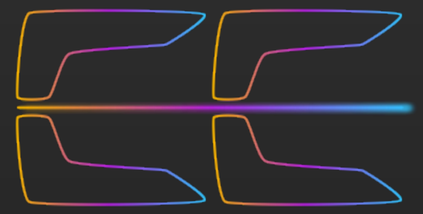


If I explain to the listeners how crazy our software system is, and why it's so difficult for legacy car companies to get software right, you'd be... I'll do it very quickly. Probably $350-500 a vehicle, we farmed out all the modules that control the vehicles to our suppliers because we could bid them against each other. So Bosch can do the body control module, someone else can do seat control, someone does the engine control module and we have about 150 of these modules all throughout the car. The problem is this software is all written by 150 different companies and they don't talk to each other!
So even though it says Ford on the front, I have to go to Bosch to get permission to change their software so even if I had a high speed modem in the vehicle and I had the ability to write software, it's actually their IP and I have 150, we call them the "loose confederation of software providers", I have 150 completely different software programming, all the structure of the software is different, it's millions lines of code and we can't even understand it all so that's why, at Ford, we decided, for the second generation of EV products, to completely insource the electric architecture and to do that you need to write all the software yourself but remember, car companies haven't written software like this EVER. So we're literally writing the software to operate the vehicle for the first time ever.

The Fully Charged Podcast - June 2023

VDK EE

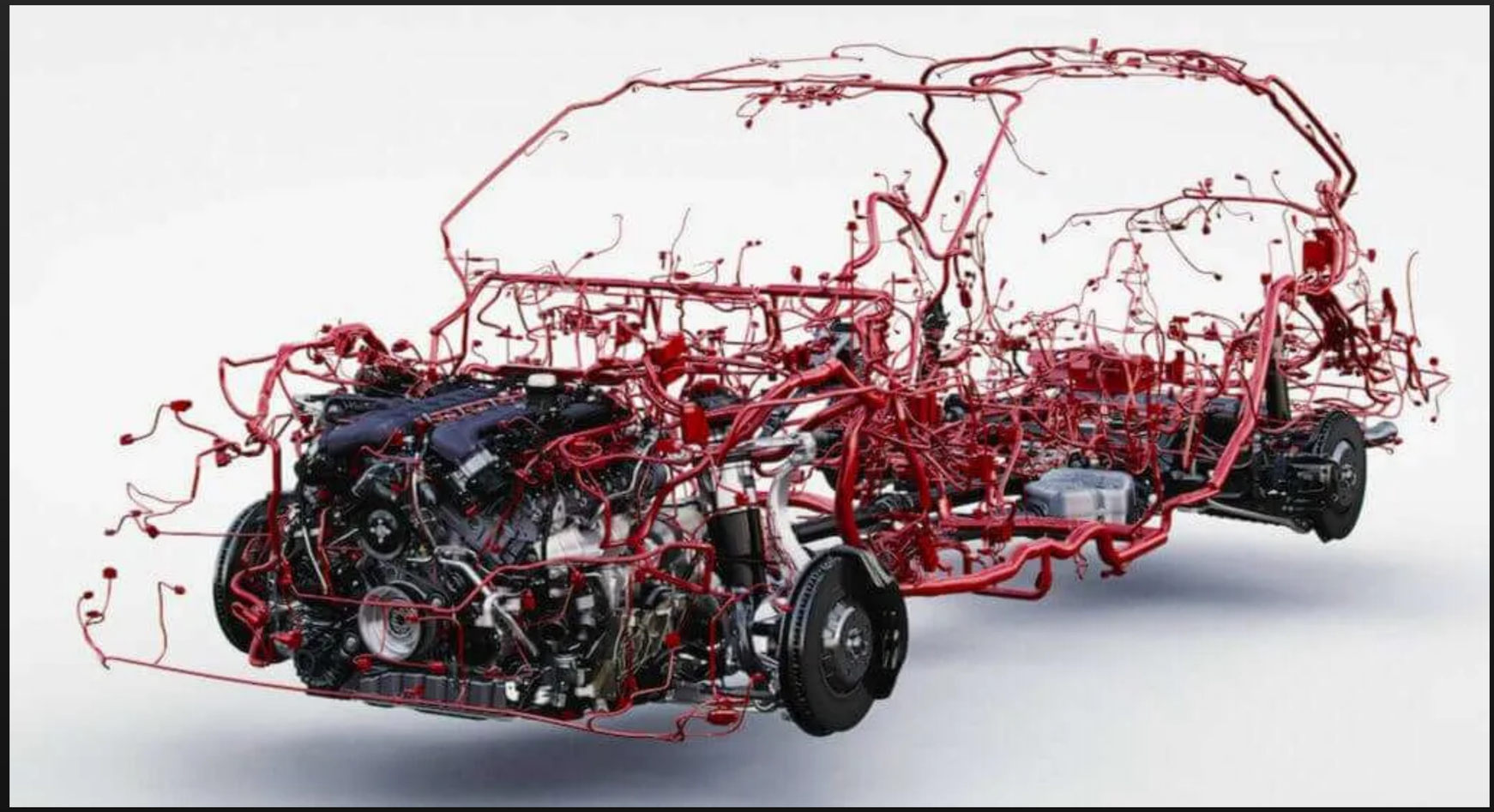
What does Jim Farley mean?



- The Automotive Industry has had the wrong approach with electronics and software for the last 30 years, outsourcing hardware and software the same way they outsource mechanical parts
- It resulted in a universe of inefficiencies in vehicles:
  - The number of electronic modules, the number of different chips, of different software stacks
  - The excess wire harness
  - The complexity of packaging
  - The complexity of software development organization
  - The complexity of code, way too many lines of codes (>150 million lines vs ~3 million in planes)
  - The borderline impossibility to maintain and fix software bugs
  - The impossibility to truly own the evolution of the digital product and release new features regularly
  - Teams of hundreds or thousands of engineers at OEMs incapable of fixing problems
  - Hundreds of millions of $ in R&D are duplicated for each module, then each vehicle, then each OEM
  - Supplier management, bugs management though suppliers, recalls, cost billions of dollars

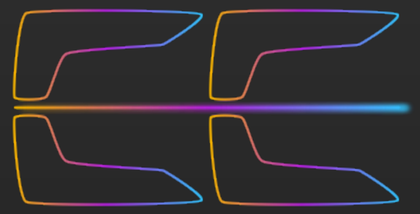
VDK EE

What does Jim Farley mean?



VDK EE

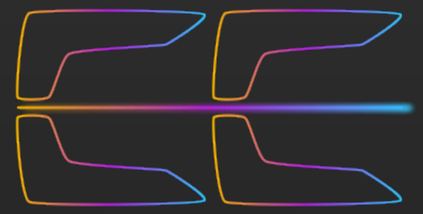
Tesla’s approach



- **100% Ethernet-Based**: For future models, Tesla has announced plans to implement an EE architecture that is 100% Ethernet-based. This approach represents a significant shift from traditional automotive wiring and network protocols towards a more unified, high-speed data communication backbone. The architecture appears as one entity when connecting to it for diagnostic or development.
- **Minimal Cross-Connects**: The Cybertruck is designed with a reduced number of cross-connects or physical wiring connections between different zones of the vehicle. This simplification aims to reduce complexity, improve reliability, and potentially decrease production costs. Simplifying the vehicle's wiring could also lead to easier maintenance and repair.
- **In the 2023 Investor Day presentation**, Peter Bannon, Tesla's Director of Electronic Architecture, invited other automakers and suppliers to join Tesla's evolution in vehicle technology. During the Cybertruck Delivery Day, Elon Musk highlighted the vehicle's 48-volt system, ethernet network, and zonal Electronic Control Units (ECUs), even sending a pamphlet to other OEM CEOs on designing 48-volt vehicles, showcasing his unique approach to industry collaboration.
- **The Cybertruck** features zonal ECUs that manage local devices within each zone, connected by a single Ethernet network. This design reduces the complexity and weight of the wiring harness and offers programming, debugging, security, and backup benefits. The next-generation Tesla vehicle is expected to eliminate cross-zone connections entirely, supporting a more streamlined production method.

VDK EE

What is the reality of EE to this day?

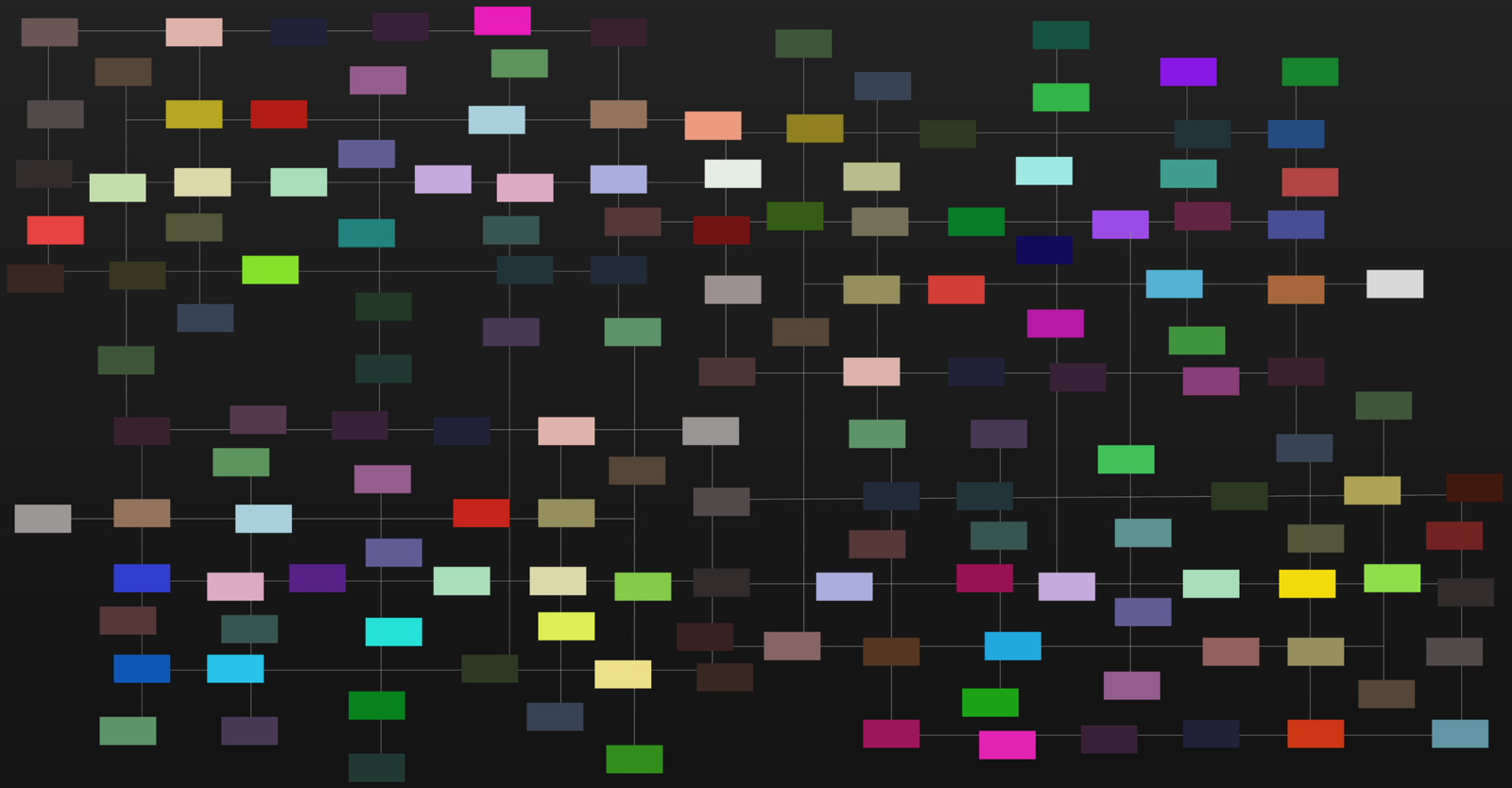


- It is a crucial strategic need for vehicle companies to own their software and control their destiny
- But it requires them to start from scratch and few are those who dare to do it
- OEMs can’t resort to insource EE because of legacy systems and supply chain
- It is going to be very difficult for OEMs to enact this change, they are mostly unwilling to do what needs to be done: rethink everything and start from a blank page
- We’ve been hearing about better architectures for almost a decade and almost no progress was made
- By the time it’s going to take to get better, the solution will already be outdated
- The industry is organized around this concept of outsourcing with very powerful tier ones
- OEM write specifications, pin tier ones against each other, get the best price and then:
  - The tier one uses the hardware/software platform of their choice as long as it performs the functions and interfaces with the rest of the vehicle as specified
  - This results in as many computing platforms as number of tier-1 companies with unmanageable and uncontrollable ECUs, all types of MCUs are used all over the place with no common strategy

VDK EE

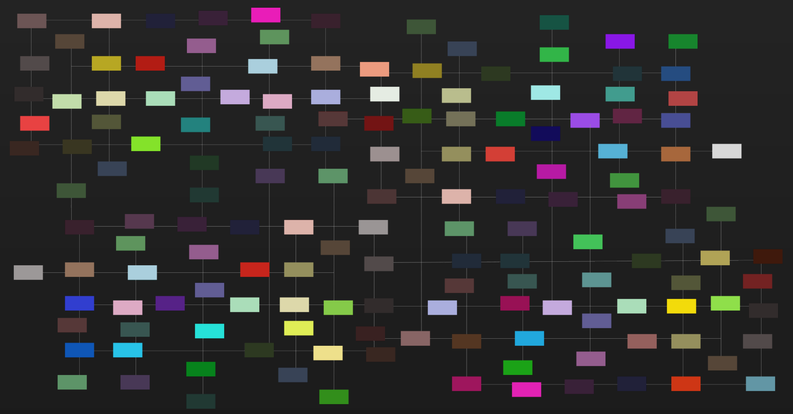
EE architecture old paradigm

IT SHOULDN’T REQUIRE 150 MODULES TO OPERATE A VEHICLE



VDK Electronics

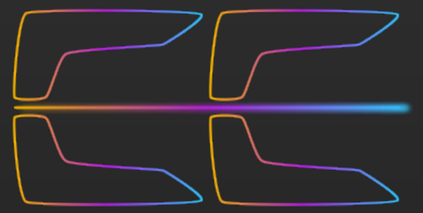
EE Architecture Optimization



- Electronic modules are merged with a reduced total of maximum 40 modules.
- EE functions are regrouped to reduce & even delete wire harnesses.
- Create EE blocks that only need power and Ethernet

VDK EE

Everything that gets better with a better EE approach



- **Testing and Integration Challenges**: The complexity and number of optional consumer features lead to hundreds of thousands of potential build combinations for individual vehicle models, posing significant testing and integration challenges.
- **Cybersecurity Concerns**: Following high-profile cybersecurity incidents, the industry recognizes the need for robust cybersecurity measures. Governments are imposing cybersecurity obligations on car makers, including certified cybersecurity management systems and software update management systems.
- **Increasing Recall Rates for Electronic Defect**s: Software-based defects have led to record recall rates, with 2019 setting a record for electronic component defects in vehicles.
- **Repair Costs and Complexity**: The integration of advanced safety features has led to increased repair costs, with calibration of these systems being a major cost driver. Repair costs are rising to the point where minor damages can lead to vehicles being declared total losses by insurance companies.
- **The Future of Vehicle Software**: The shift towards EVs and autonomous driving is expected to further increase software complexity, necessitating new vehicle software and physical architectures. The industry faces a "development-productivity gap" with software complexity growing faster than the ability to develop and maintain it.
- **Executive Challenges**: There is a noted lack of software expertise in the executive ranks of automotive companies, highlighting a need for a shift from a hardware-first to a software-first mentality in the industry.

VDK Platform

Product

Road-ready autonomous mobility projects face cost, legal and technological challenges.

Current Level 4 autonomy tops at 35 mph – categorizing road-ready autonomous mobility solutions as low-speed vehicles (LSV) in the US.

Existing companies prioritize AI and Vision over hardware development – leaving a gap in achieving full vehicle certification and market readiness.

VDK fills gap bringing road-ready platforms to market that support the advancement of autonomous vehicles from experimental to operational – capitalizing on the market opportunity.

VDK Platform

Unique Technology

Power

22-44kW Continuous
2WD, 4WD or 6WD

Max speed

55 mph in Free Version
35 mph in LSV Homologation
TBD Version Compatible with AD Kit

Battery

11.5-64 kWh
Minimum Range Over 100 miles
Range Modular According to AD Kit Needs

Wheelbase

90, 120 & 150 in.

Voltage

96 & 12 V (DC/DC)

Payload

Up-to 3000 lb.

Steering

2 or 4-Wheel

VDK Platform

Certified & Validated

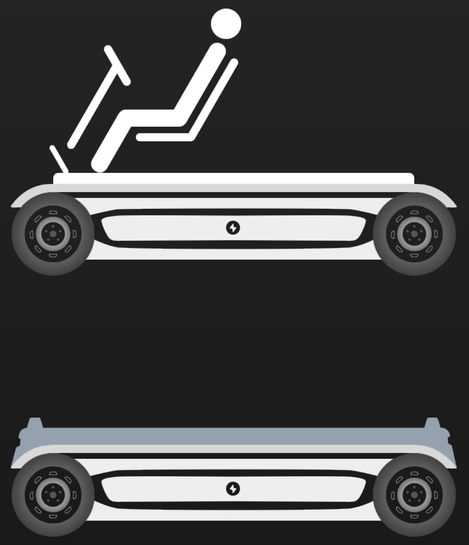
In-Wheel Motor
R85 Certification

Battery packs
R100-2 & UN38.3 Certification

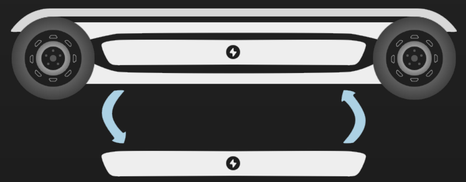
2 & 4-Wheel Drive
>100,000 Validated Road-Miles

VDK Platform

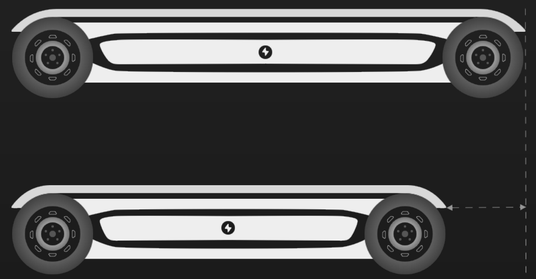
Platform Highlights



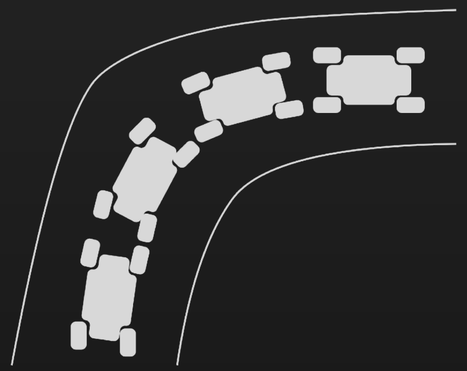
Human or Autonomous
Driving Compatibility



Fast Swappable
Battery Pack



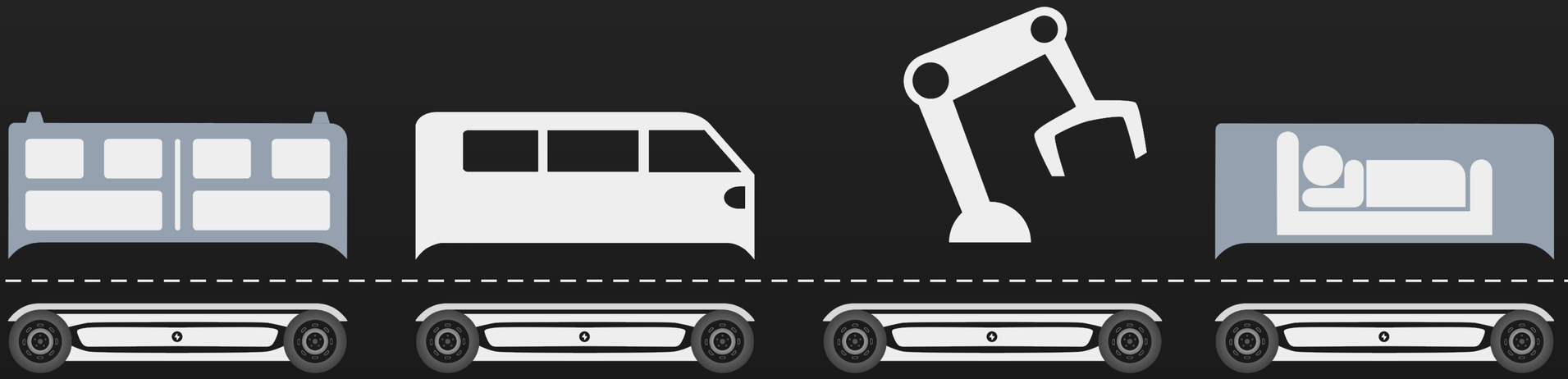
Modular
Wheelbase



Virtual Tramway
for narrow streets

VDK Platform

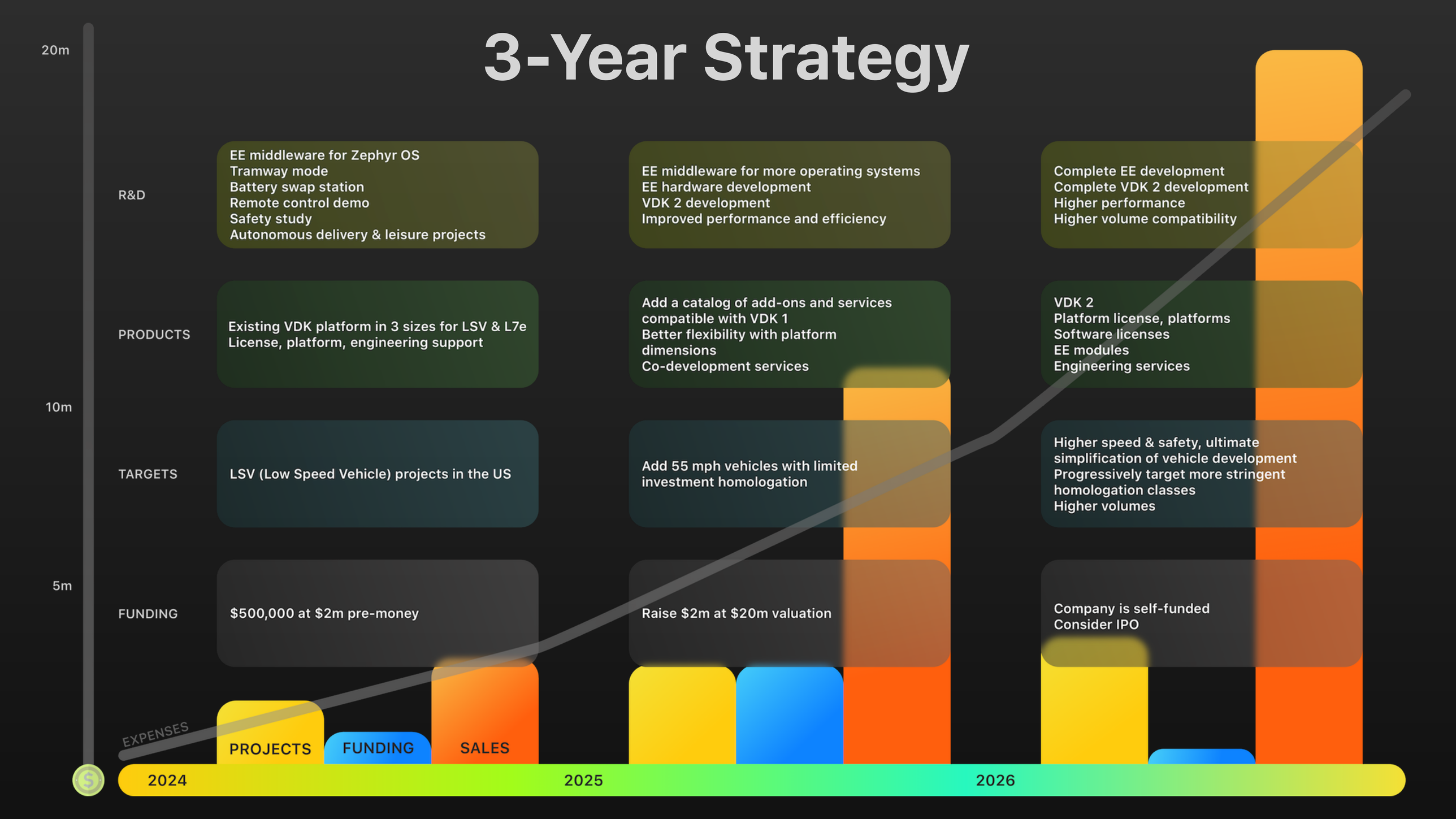
Built to Evolve



Free From Constraints
Your Creativity
Your Product

Our Development Kit
Certified & Validated

3-Year Strategy



VDK Electronics

Total Simplification

Enormous economies of scale at many levels, systems are developed once and reused instead of infinite replication.