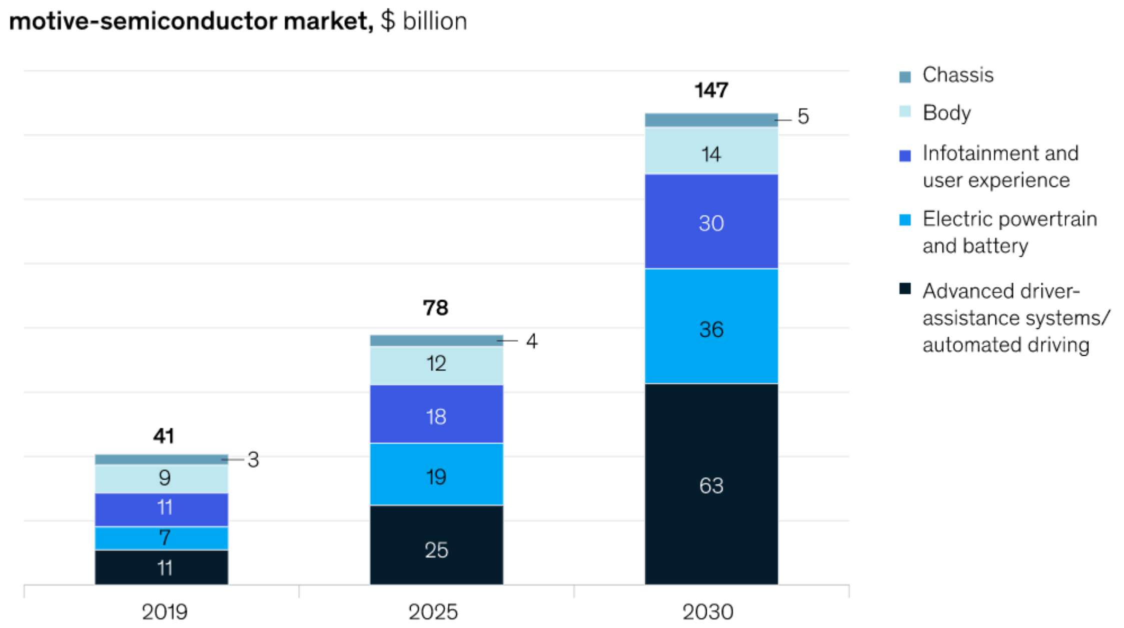
Advancements in Automotive Semiconductors and Challenges

Automotive Semiconductors: Growing Demand

Automotive OEMs have started to react to semiconductor market challenges due to continuous shortages and changing landscape of automotive system architecture.

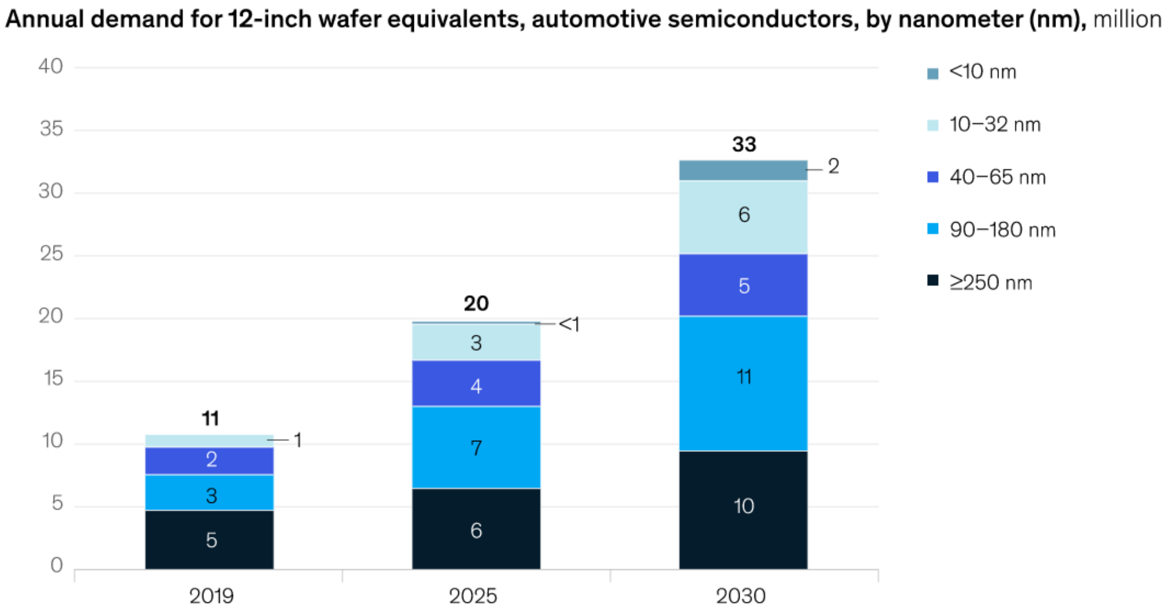


Reference: McKinsey & Company

Most of the demand in automotive semiconductors Twill be driven by three areas—**Autonomous Driving, Electrification, Infotainment and Connectivity.**

Automotive Semiconductors: Demand Spread Over Cutting Edge and Legacy Nodes

The demand will grow on both cutting edge and legacy nodes, but most of the future automotive-wafer demand will involve legacy nodes of 90 nm and above.



Reference: McKinsey & Company

Majority of vehicle controllers and electric powertrains are based on chips manufactured on legacy nodes, which will account for about 67 percent of automotive demand in 2030.

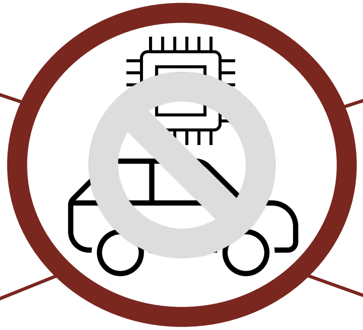
Automotive Semiconductors:
The Demand-Supply Mismatch May Persist For All Nodes.

- While the demand for 12-inch automotive wafers is expected to grow at a CAGR of 11%, increase in the production of 90nm wafers is expected to increase at 5% only until 2026.
- There is a little incentive to migrate these designs to smaller nodes, because of the expensive design migration, as well as more R&D staff which is in short supply as well. Also, high voltage designs won't benefit from the PPA scaling of newer nodes.
- Even though the leading-edge nodes have higher CAGRs of 9%, but because of intense cross-industry competition, these nodes may remain constrained as well.

Automotive Semiconductors: The Other Factors.

OEMs' **selective manufacturing** and sales strategies to optimize margins, cause extreme fluctuations in demand for automotive chips.

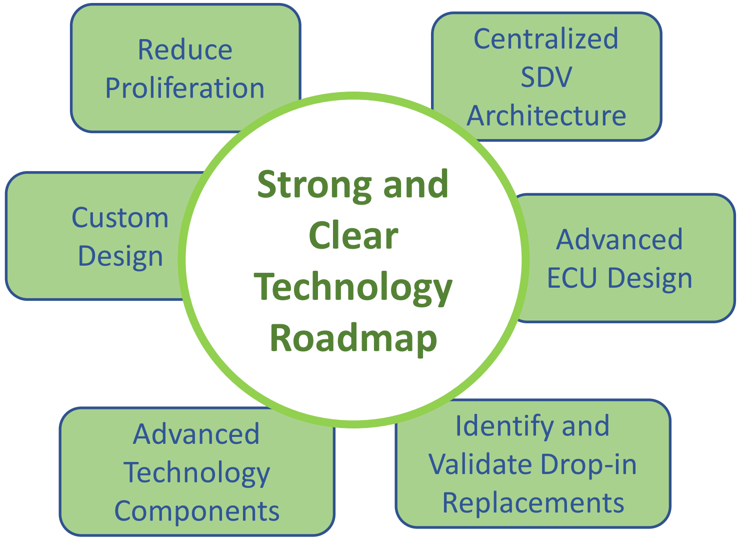
A chip could travel more than 25,000 miles before completion. Transportation costs and constraints are fueling the long lead times.

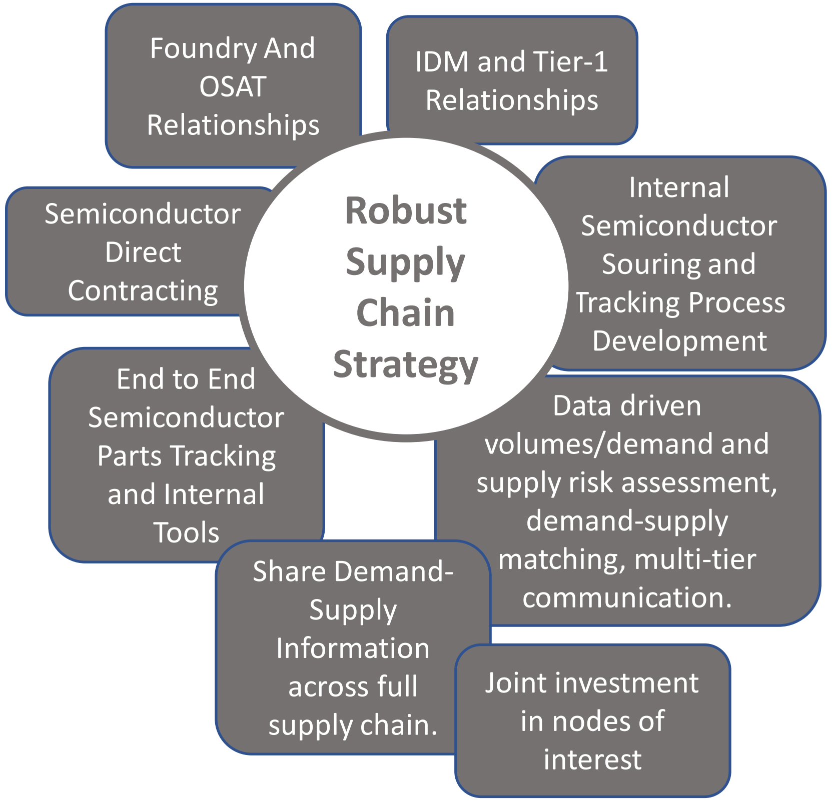


Missing long term volume projections and unclear technology roadmap from automotive OEMs.

Some OEMs are ordering surplus and stocking up semiconductors which is causing the long lead times and instability in the supply chain.

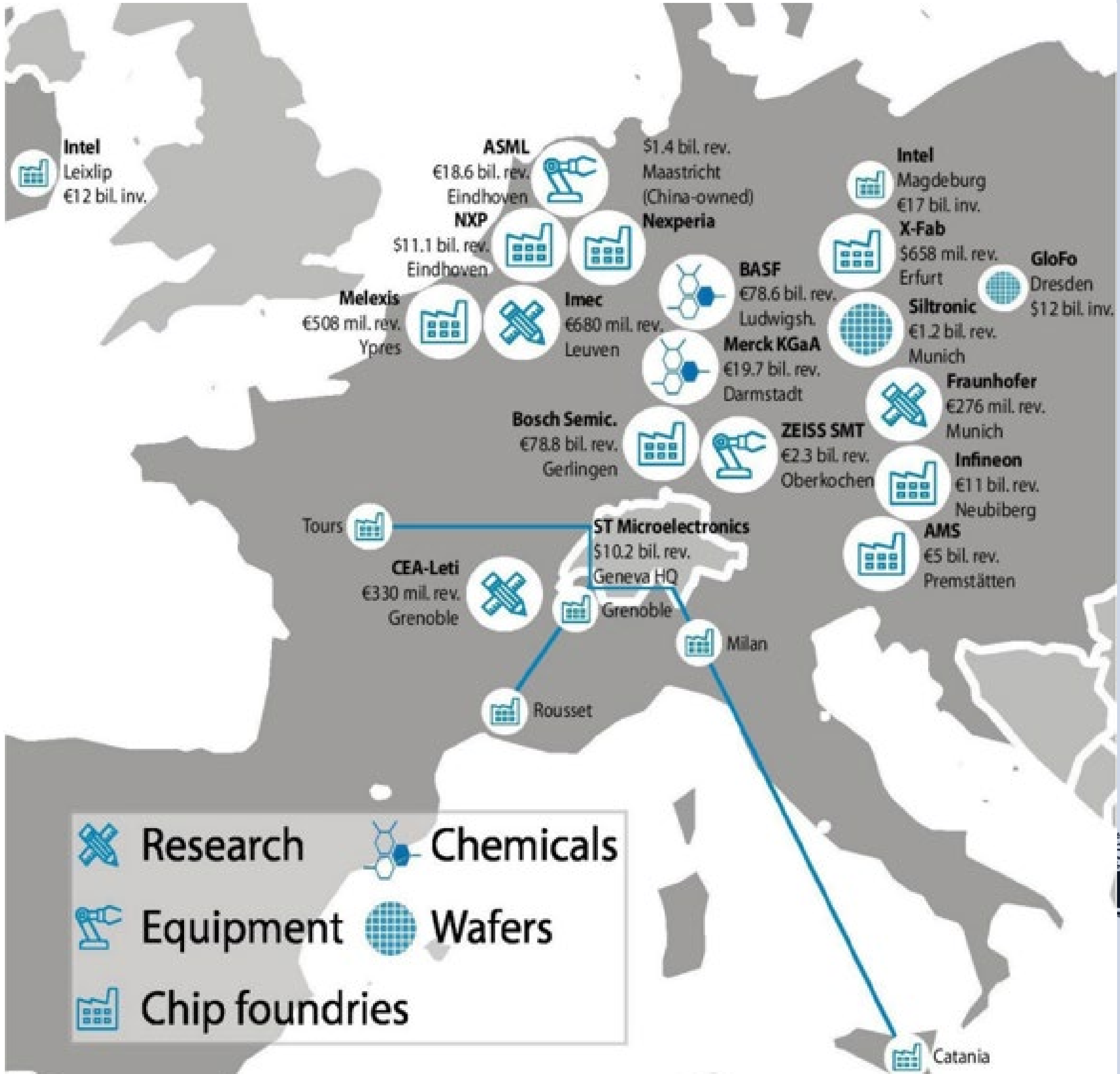
Automotive Semiconductors: How can OEMs succeed? A Short- and Long-Term Strategy





Footprint: Europe: Manufacturing, R&D Growth Opportunities

Intel	Up to €80b for Fab, Packaging, R&D. €17b for Mega Fab in Germany, with extensions in Ireland, Italy, Poland and Spain. R&D and design hub in France.
GF	Plans to expand the Dresden facility with $1B. Globally expanding capacity to 850,000 wafers. Partnership with ST Micro to open a facility in France.
ST	ST Micro has 6 out of 14 sites in Europe. Building a Silicon Carbide substrate facility in Italy.
Infineon technologies	Approved a $5B new 300mm Fab in Dresden. Approved recently completed a 300mm Fab in Villach, Austria.
BOSCH	Recently completed phase 2 of 300mm Fab in Dresden, Germany. Planning capacity expansion in next 2 years for automotive and electrical Vehicles.
tsmc, SAMSUNG	Both TSMC & Samsung are seeking sites in Europe and may announce mega sites like US.
Texas Instruments, Micron	No announcements from TI or Micron yet.



Source: European Strategy and Policy Analysis System **(ESPAS)** Global Trends Report

Global Footprint: US & Asia: Manufacturing Growth Opportunities.

Multiple new fabs are announced in Arizona, Ohio and New Mexico with an investment up to $50B for advanced processes Intel 20A/18A. Investment may grow to $100B in next decade.

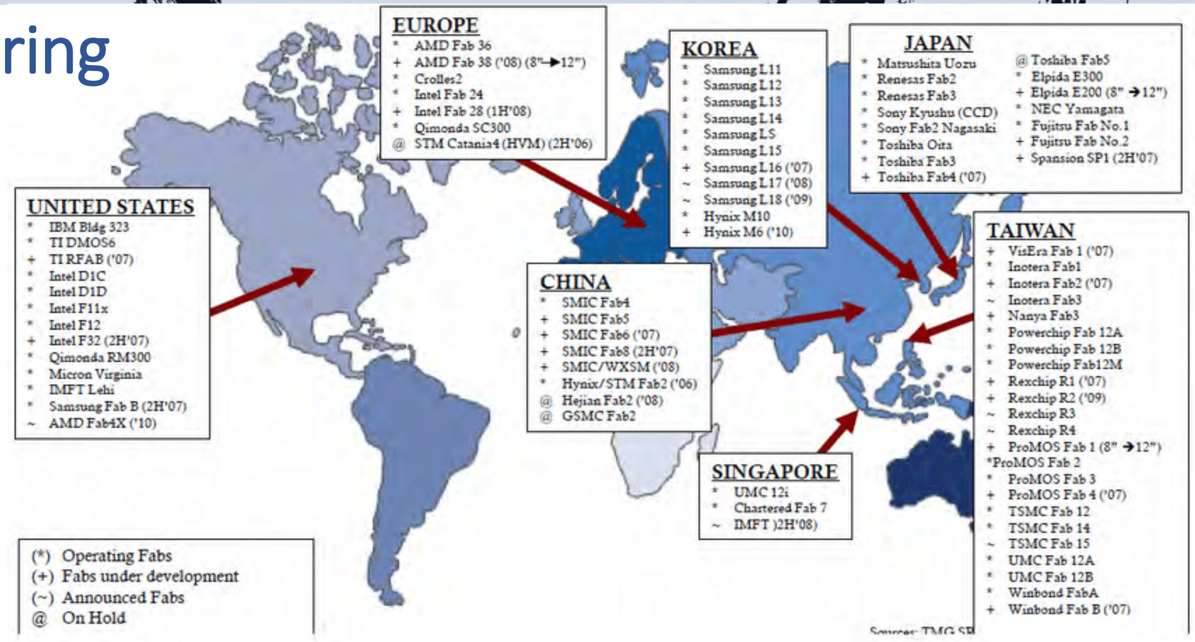
New facility on Phoenix, Arizona with investments up to $12B for 5nm and 4nm processes. 6-phase growth plan for up to $40B.

$17B committed for a new Fab in Taylor, Texas.
Potential investments up to $192B in Taylor, TX over next 2 decades based on business case.

Investment of $30B in 4 phases in Sherman, Texas.

Capacity upgrade to existing Fab in Mata, NY with an investment of $1B.
Potential new fab in Malta, NY based on business case and funding.

Up to $100B over the next 2 decades for a new mega fab in Clay, New York.
First phase investment of $20B planned by the end of this decade.



SAMSUNG announced to invest $228B in **KOREA** to create world's largest chip facility in next two decades.

AMKOR announced to invest in **PORTUGAL** facility to support Europe's semiconductor manufacturing growth.

Manufacturing focus is shifting out of East Asia to local locations.

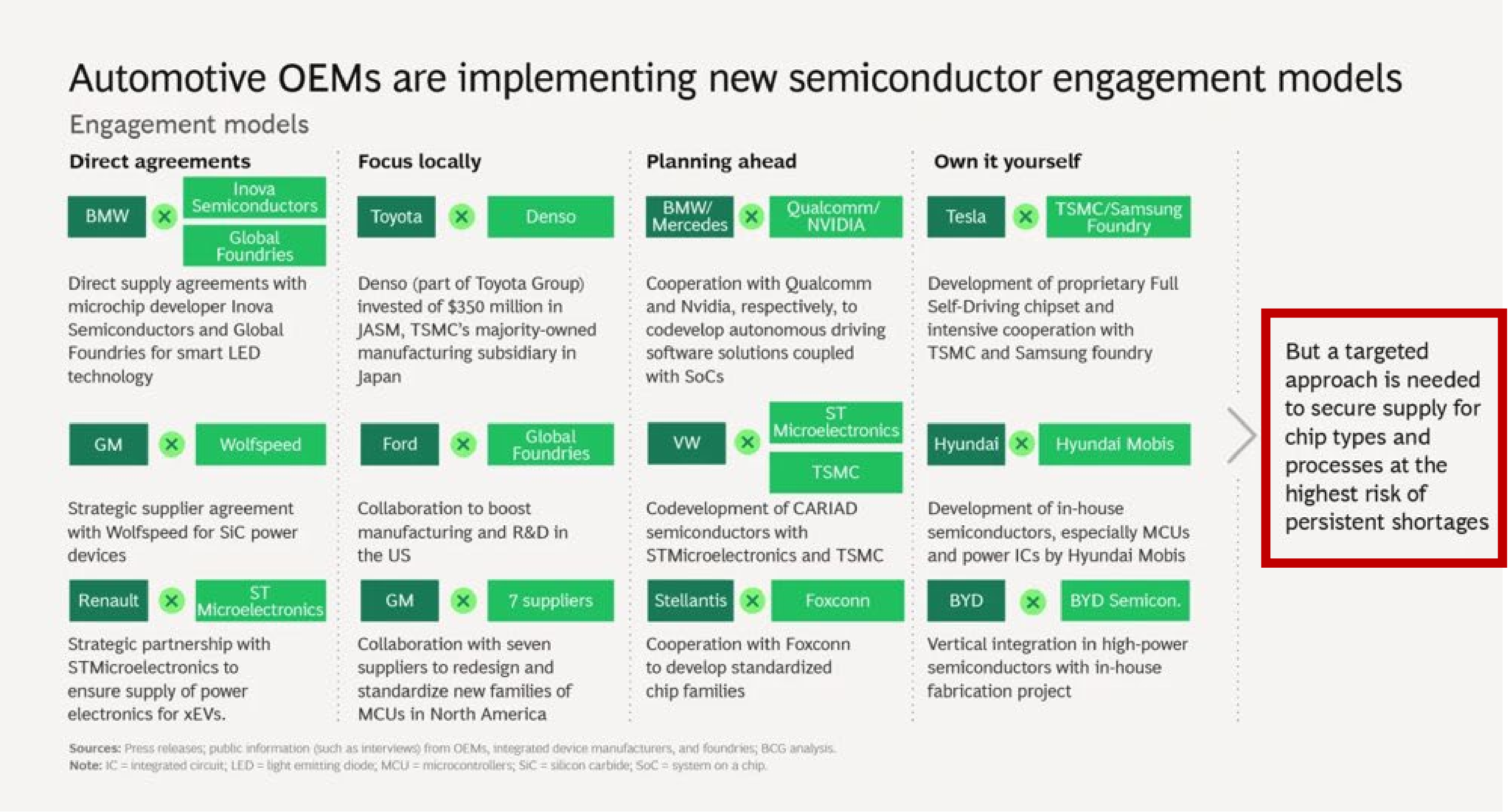
Entire ecosystem needs to scale to meet the manufacturing growth.

Perfect time for for automotive OEMs to create relationships and/or co-invest.

Align semiconductor portfolio with manufacturing footprint and growth.

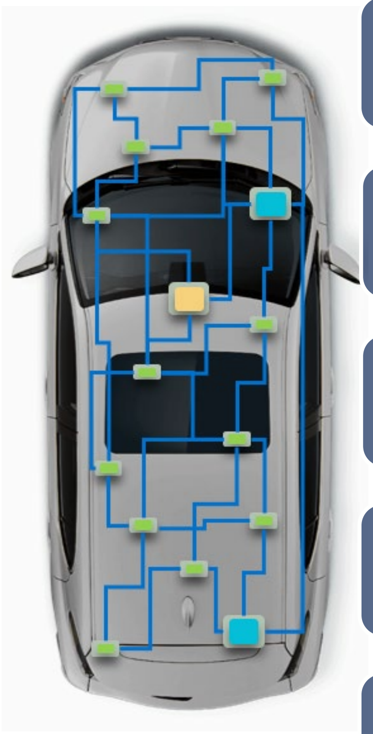
Automotive Semiconductors:
OEMs are rushing to announce partnerships.

- ✓ Direct Agreements
- ✓ Focus Locally
- ✓ Planning Ahead
- ✓ Own it Yourself



Automotive Architecture: Zonal to Centralized SDV

Legacy Architecture



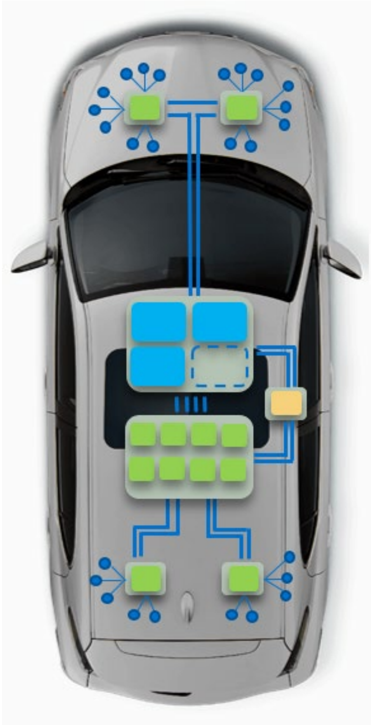
- Highly distributed, unscalable, massive integration required for compute upgrades
- 50+ unique ECUs per program, 100's of different ECUs
- 70+ Unique Processors - uncontrolled supply chain
- Single program cost optimized
- Fast time to market, but still limited by architectural constraints

Design Optimization is the key.

Scalable Semiconductors enable in market enhancements and long-term revenue. Vehicle and feature refresh and updates are possible.

Centralized SDV

- Centralized, highly scalable, upgradable by customers in field
- ~70% reduction in ECU per program
- Semiconductors with 7-year design life, secure supply control
- Enterprise cost optimized, new sales opportunities after SOP
- Industry leading time to market for software development



Automotive Semiconductors: Processing: Workload Balancing

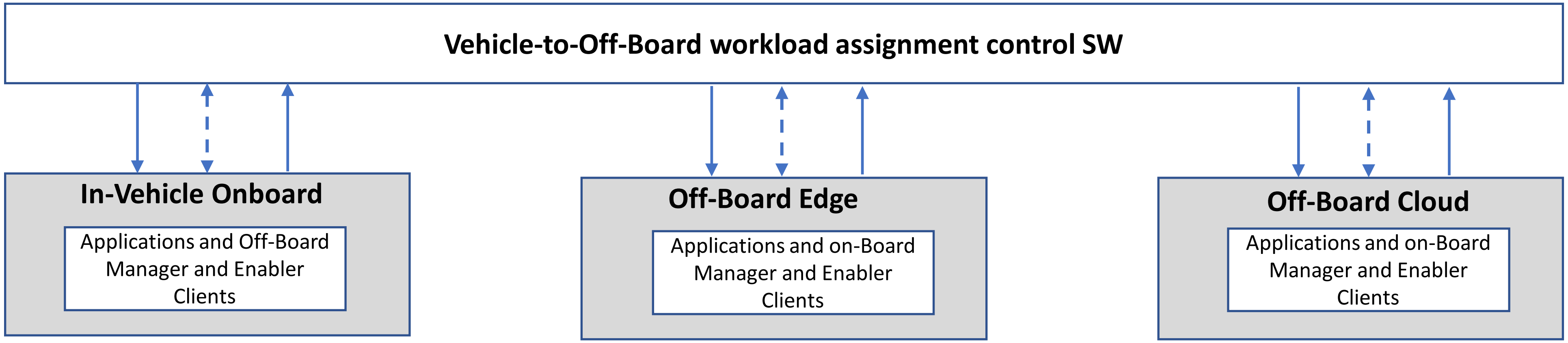
Application Processing Locations

In-Vehicle Onboard
- ADAS Features, accident prevention
- Mechatronics and vehicle control
- Critical computing features, cooling control, airbag, safety features

Off-Board Edge computing
- Situational awareness systems
- Traffic management systems
- Third party services

Off-Board Cloud computing
- OTA updates
- In-car Office
- Content streaming
- Navigation

Know your processing resources, workloads, resource utilization and let SW help decide where to process.



Semiconductors: Sustainability Challenges

The surge in demand for semiconductors is bringing to light the industry's carbon emissions, pushing for a closer look at sustainability.

- Energy Consumption
- Chemical Usage and Waste
- Water management

- Renewable Energy Integration
- Closed Loop Manufacturing
- AI Usage in Manufacturing
- Green Chemistry Manufacturing Processes
- Responsible Material Sourcing
- Efficient Water usage and Recycling
- Reduce air and water Pollutants
- Technology Development & New Materials

Thank You!