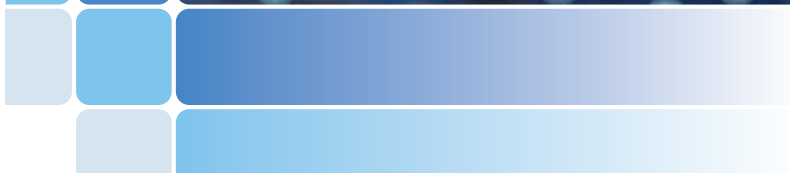
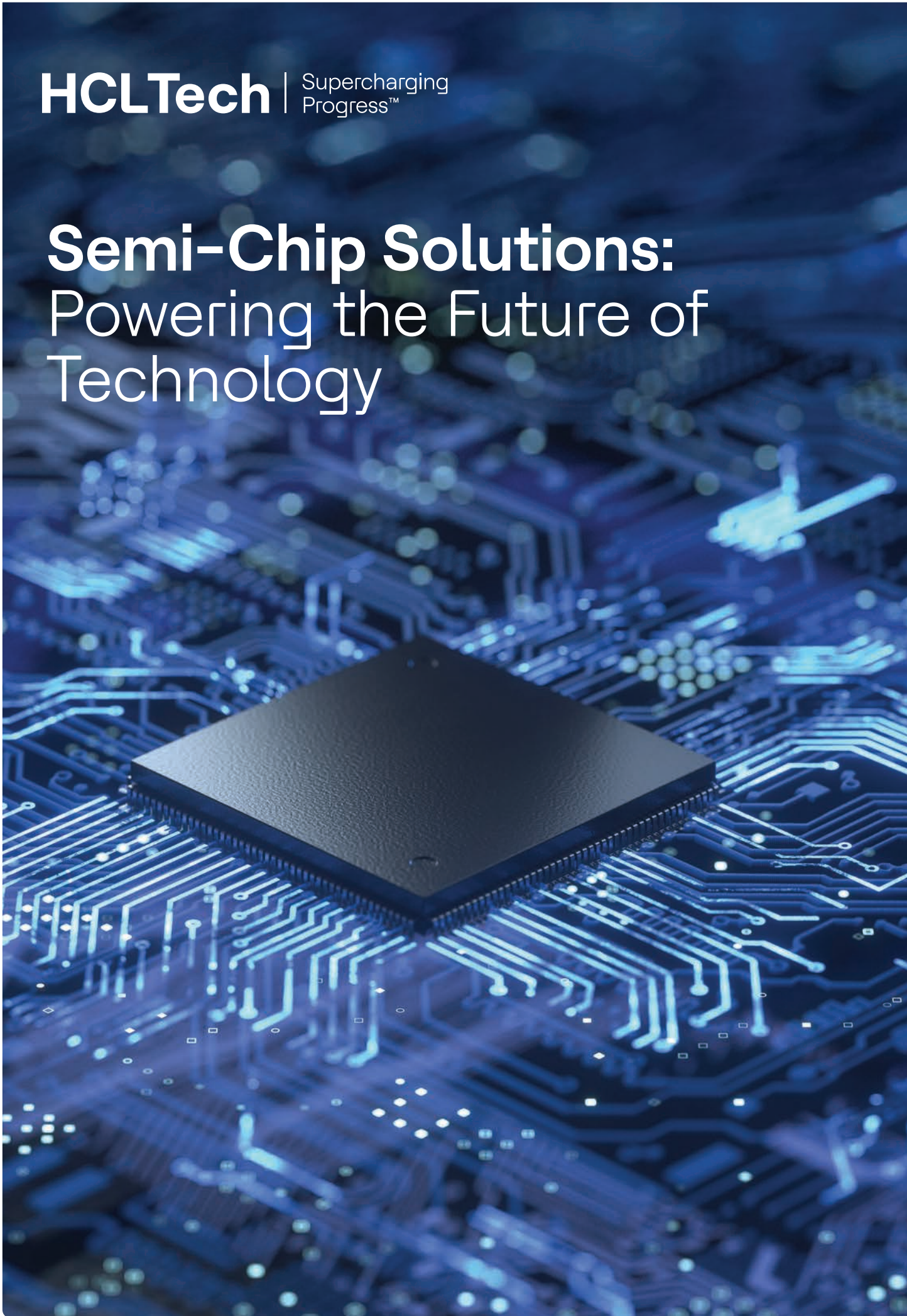


HCLTech | Supercharging
Progress™

Semi-Chip Solutions: Powering the Future of Technology



1. Who We Are

HCLTech is a global engineering and technology leader with over four decades of semiconductor, hardware and software experience. We serve diverse industries—automotive, industrial, healthcare, consumer electronics, and beyond—delivering end-to-end solutions that seamlessly integrate **chip design, hardware development, and firmware/software expertise.**

2. A Global Leadership Story



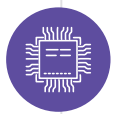
27+ years in semiconductor engineering



46+ years in hardware design excellence



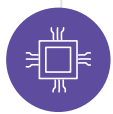
Recognized by industry analysts for leadership (Everest, Zinnov)



4300+ specialized semiconductor engineers and 1000+ firmware experts



Global lab infrastructure enabling first-silicon success across advanced and mature nodes



200+ Tapeout

3. Our Holistic Approach

- **Turnkey Semiconductor Services:** From specification to parts, covering architecture, front-end/back-end design, tape-out, and post-silicon validation
- **System Hardware & Board Design:** PCB layout (SI/PI/EMI-EMC), assembly, mechanical integration, and testing

- **Firmware & Software:** Bootloader bring-up, RTOS/OS development, driver integration, and application-level support
- **Partner Ecosystem:** Collaborative relationships with top foundries, IP vendors, OSATs, and EDA tool providers

4. Why HCLTech?

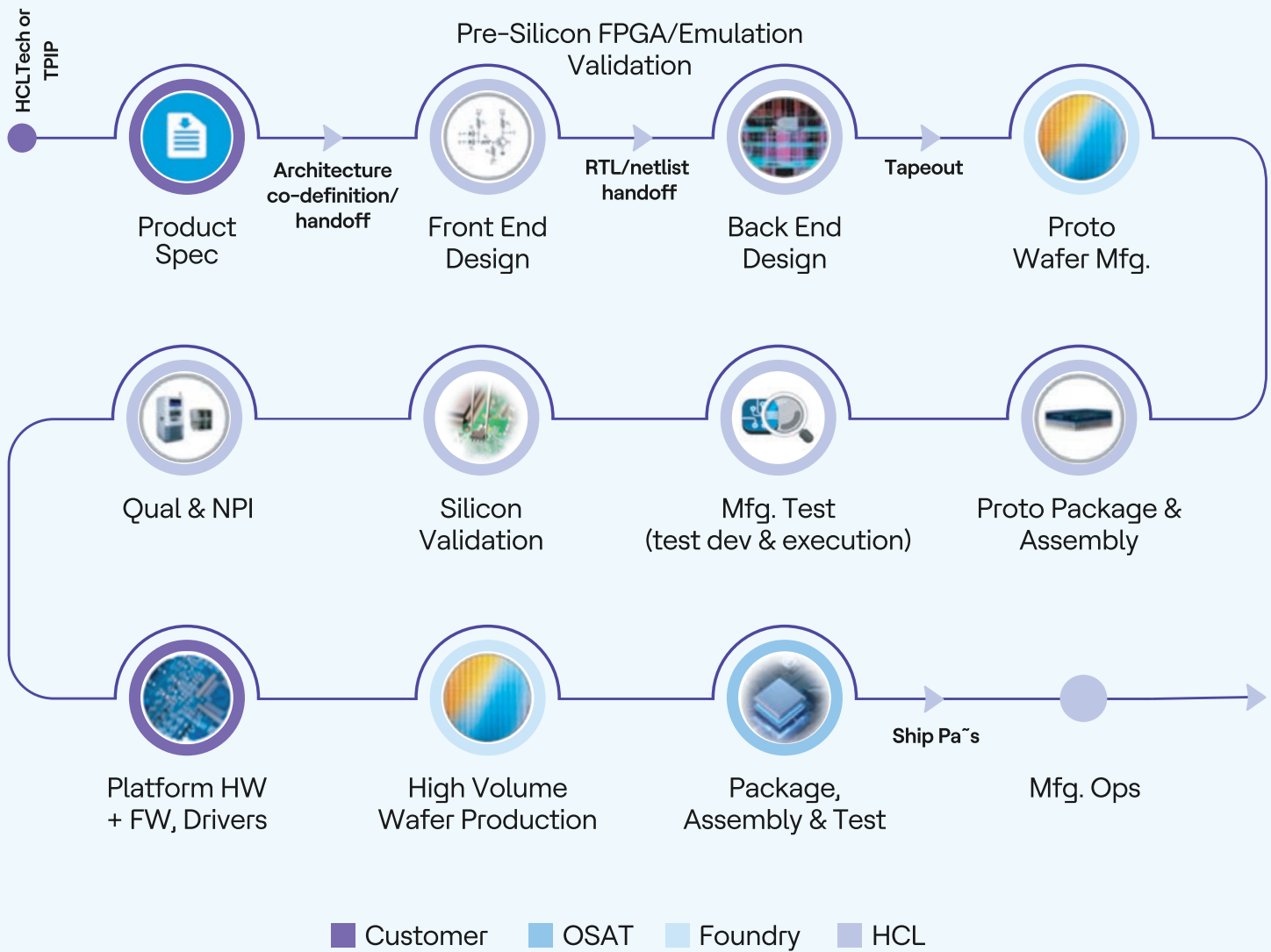
- **One-Stop Partner:** Comprehensive offerings under one roof—semiconductors, hardware, and software
- **Deep Domain Knowledge:** Automotive, industrial, consumer, networking, healthcare and more
- **Proven Innovation:** Advanced IP reuse, GenAI-driven design flow (Progenix), ready RISC V and Arm based platforms to reduce time-to-market
- **Scalable & Secure:** Multi-geography engineering centers, robust supply chain alliances, automotive-grade quality (AEC-Q100, ISO 26262 compliance)

With HCLTech, customers gain access to a global engineering powerhouse that delivers **faster time-to-market, reliable first-silicon success, and robust system-level integration**—all backed by an ecosystem of cutting-edge semiconductor supply chain partnerships.



1. End-to-End Chip Design and Delivery

Below is an illustrative flowchart capturing our **Spec-to-Pa~s** approach. Each stage is seamlessly integrated for **predictable** milestones and **on-time** tape-outs.



• Front-End Expertise

- Microarchitecture and IP selection (including analog/mixed-signal)
- RTL design, integration, and advanced verification (UVM, Formal, MSV/AMS)

• Back-End & DFT

- Place-and-route (P&R), timing closure, power optimization across advanced nodes and mature nodes
- Comprehensive DFT strategy (scan, BIST, boundary scan) to ensure high test coverage and yield

• Lab Infrastructure & Post-Si Validation

- Global labs: \$50Mn+ investment, advanced ATE, Electrical, Qualification, mmWave/RF testing, thermal chambers
- **AEC-Q100, JEDEC** compliance testing for automotive/industrial reliability
- 95%+ first-silicon success track record through robust pre-silicon verification and post-silicon debug

• Progenix-GenAI Productivity

- Accelerated time-to-market via **AI-driven automation** for specification analysis, test case generation, and design verification
- Human-like interpretation of design specs to boost coverage, reduce errors

Progenix–GenAI for SoC & Board Co-Design

- AI-driven automation that reads spec documents, auto-generates test plans, verification benches, and firmware scaffolding
- Delivers **up to 35%** productivity gains in design verification and driver development

Semiconductor Case Studies

1. Radar SoC for Advanced Driver Assistance

- **Process:** TSMC 16nm; **Complexity:** ~20M gates, integrated analog blocks (Cortex R5, M0+)
 - **HCLTech Ownership:** Front-end design, back-end, DFT, post-silicon validation
 - **Outcome:** First-pass silicon success; robust sensor fusion for autonomous driving
-

2. AI Edge Compute ASIC

- **Process:** UMC 40nm; multicore ARM, custom analog IP, memory subsystem
 - **HCLTech Contribution:** SoC architecture, RTL, mixed-signal verification, AI acceleration
 - **Outcome:** 15% faster development cycle using re-usable IP, real-time inference at low power
-

3. Image Co-Processor SoC for Mobile

- **Process:** TSMC 28nm HPC; Complexity: ~65M gates with MIPI, PCIe, LPDDR4
 - **HCLTech Scope:** RTL-to-GDSII, advanced DFT, pre-silicon emulation, post-silicon debug
 - **Outcome:** Delivered on an aggressive 8-month schedule with “first-time-right” tape-out
-

4. Analog Chip AC-DC Controller

- **Complexity:** Full chip ACDC controller IC design to control switching of LLC+PFC power adapters - 480Watts - AC input 115V, 60Hz & 230V, 50Hz - Multiple output voltage settings
- **HCLTech Scope:** Analog IP Development (LDO, BGR, 200MHz OSC, ADC, DAC, Tx, Rx, Comparators and Amplifiers); Testing and Silicon validation support for PFC+LLC (LV) die and High Voltage Driver (HV) Die; Board development & characterization of combined die packaged IC
- **Outcome:** Silicon Proven die

By leveraging in-house firmware and software expertise, HCLTech ensures each silicon or board design is fully realized, tested, and optimized for **top-tier performance, security, and reliability**—ready to power the next generation of connected systems.

Ecosystem & Partnerships

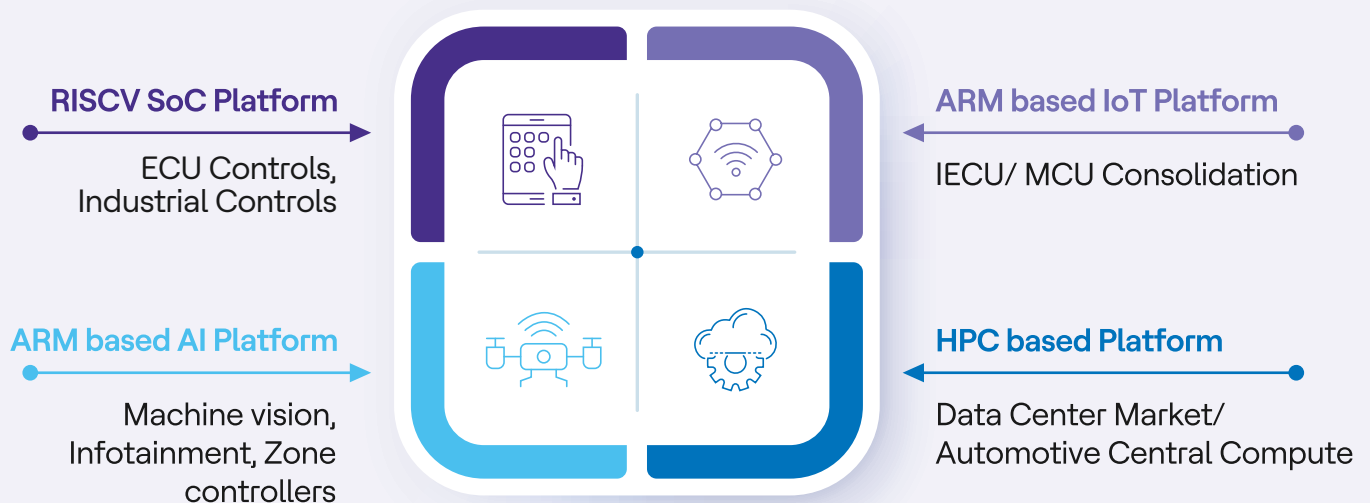
- **Foundries & OSAT:** Intel Foundry Services, TSMC, Samsung, GF, ASE, Amkor and more
- **IP & EDA Vendors:** Synopsys, Cadence, Arm, Rambus, CEVA, and more
- **Multi-Domain:** HPC, AI accelerators, automotive-grade MCUs, industrial IoT SoCs, connectivity solutions

Together, these turnkey semiconductor services lay the foundation for rapid, risk-mitigated chip development—backed by our proven partnerships, GenAI-driven automation, and comprehensive lab validation.

Our Competitive Edge:

Innovative Accelerators, Proven Methodologies, and a Scalable Ecosystem

HCLTech Platform Solutions for Various Markets



HCLTech Differentiators

1. **Comprehensive Engineering Under One Roof**
 - Deep expertise across **semiconductor, hardware, and firmware** ensures **vertical integration**—from RTL coding to board bring-up and system software
2. **RISC-V & ARM-Based SoC Platforms**
 - **Pre-verified blocks** for CPU subsystems, secure boot, memory controllers, and AI/ML accelerators
 - Configurable for automotive ECUs, industrial controllers, or consumer applications—enabling **faster time-to-market** and reduced risk.
3. 10+ global engineering labs, supporting onshore/offshore/offsite models
4. Scale resources rapidly to meet varying project demands, cost, and time-to-market objectives
5. **Automotive-Grade Quality & Beyond**
 - In-house **AEC-Q100** testing and **ISO 26262** functional safety alignment for automotive customers; equally adept in industrial, consumer, and HPC domains
6. **Supply Chain Assurance**
 - Strong alliances with leading foundries, OSATs, and IP vendors for multi-sourcing, ensuring **long-term component availability** and lower supply risk

Firmware services

1. Seamless Firmware & Software Integration:

Bridging Silicon, Board, and Applications

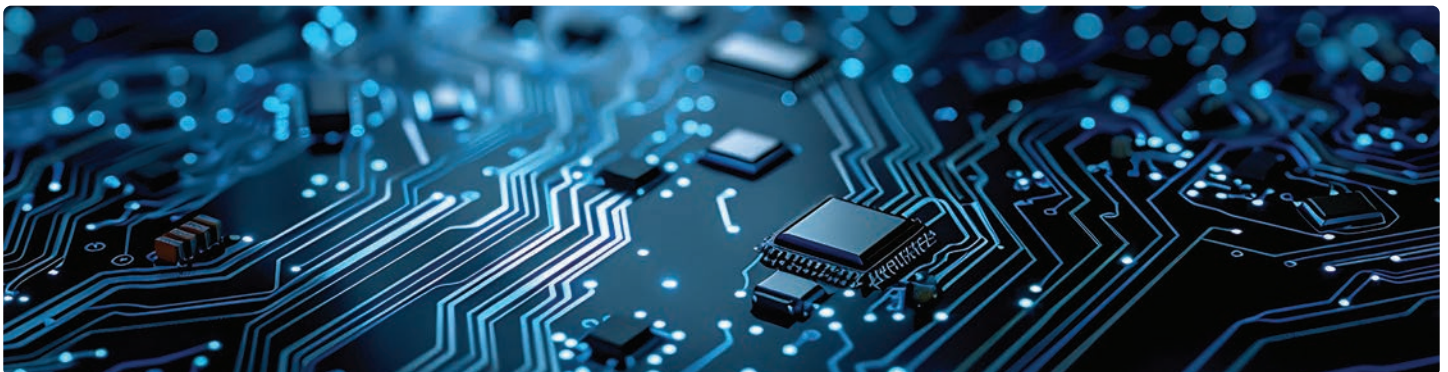
- **Bootloader Development & Board Bring-Up**
 - Experience with U-Boot, RedBoot, pmon, and custom ROM bootloaders on various architectures (ARM, RISC-V, x86)
 - Early platform initialization (DDR, CPU, I/O) and secure boot mechanisms
 - **RTOS & OS Pooring**
 - VxWorks, ThreadX, FreeRTOS, QNX, Zephyr, Linux, Android, plus proprietary microkernels
 - Low-level BSP creation, driver integration, hardware abstraction layers
-

2. Device Drivers & Protocol Stacks

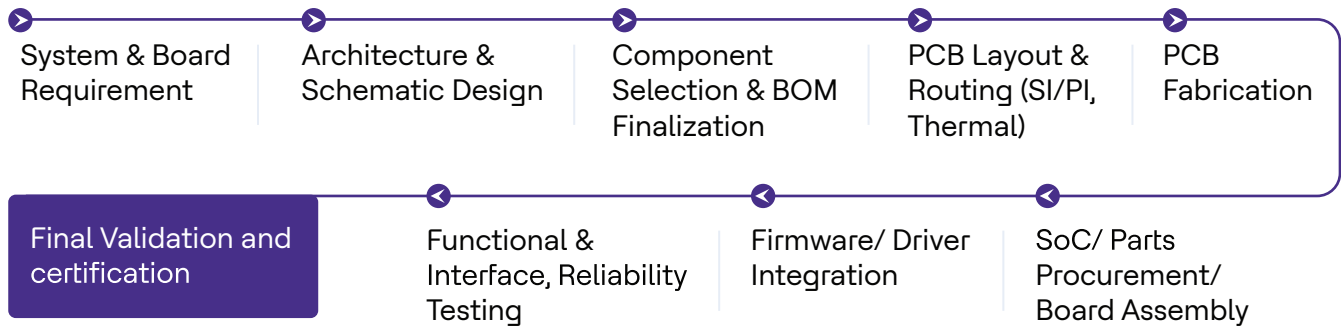
- **Communication & Interfaces**
 - TCP/IP, EtherCAT, SMB, industrial protocols (Modbus, Profibus), automotive protocols (CAN, LIN, FlexRay)
 - High-speed interfaces (PCIe, USB, Ethernet, MIPI, LVDS) and low-power I/Os (SPI, I2C, UART)
 - **Peripheral & Sensor Drivers**
 - Audio, imaging, accelerometers/gyros, network controllers, security accelerators
 - Integration of advanced IP blocks (GPU, AI accelerator, DSP) with custom driver stacks
-

3. Higher-Level Software Services

- **OS Adaptation & Application Frameworks**
 - Custom OS builds (Yocto-based Linux distros, embedded Android), device tree config, kernel modifications
 - Application libraries for AI/ML, vision, and real-time control
- **Firmware QA & Testing**
 - Unit testing, integration testing, stress validation, on-target debugging
 - Continuous Integration/Continuous Deployment (CI/CD) pipelines for embedded builds



End-to-End Hardware Board Design Services



1. Requirements & Architecture

- Collaborate with customers to define system requirements, use cases, and constraints
 - Derive hardware architecture and key component selections
-

2. Schematic & PCB Design

- **Schematic Capture:** Define interconnects and finalize BOM
 - **PCB Layout:** Ensure signal and power integrity, and EMI/EMC compliance. Optimize for high-speed signals, thermal management, and mechanical constraints.
 - Apply DFM/DFT best practices for manufacturing and testing
-

3. Fabrication & Assembly

- Partner with top **PCB manufacturers** for production
 - Use automated assembly lines with **X-ray/AOI** inspection for quality
-

System Integration & Validation

1. Firmware & Driver Integration

- Board bring-up with custom or off-the-shelf OS, bootloader, and drivers
 - Use HAL layers for quicker application development
-

2. Reliability & Environmental Testing

- Conduct functional and environmental stress tests, ensuring compliance and certifications
-

3. Lifecycle & Sustaining

- Manage product revisions, obsolescence, and field support
- Maintain comprehensive design documentation and PLM

Case Studies

- **Automotive:** ECUs (ADAS, infotainment, BMS, telematics), compliance with AEC-Q100 and ISO 26262
- **Industrial & Consumer:** Control boards, robotics, IoT gateways, consumer electronics with advanced connectivity
- **Medical & Aerospace:** Specialized safety and reliability requirements, rigorous validation standards

Hardware & System Case Studies

1. HVAC System Hardware Platform

- **Goal:** Develop a modular, scalable hardware/software platform to boost productivity by 50% and cut costs by 20%
 - **Scope:** Standardized microcontroller and PCBA, modern open communication interfaces, architecture across four product subsystems
 - **Result:** Reduced design variants, faster prototyping, and improved cross-geo collaboration
-

2. Vehicle Control Unit (VCU) for EV

- **Goal:** ASIL C-compliant hardware/software for critical EV functions (motor inverter, cooling)
 - **Scope:** Hardware design, platform software (bootloader, drivers), and prototyping
 - **Result:** Production-ready VCU with AUTOSAR support, secure boot, and real-time control—accelerating EV launch
-

3. Battery Management System (BMS)

- **Goal:** Universal, scalable BMS (36V–400V) with cell balancing and SOC/SOH estimation
- **Scope:** Master/Slave board design, safety protection (over/under voltage/current, thermal), firmware for data logging and diagnostics
- **Result:** Flexible BMS supporting multiple EV/LEV configurations and enhanced reliability

Our semi-chip solutions are at the forefront of technological innovation, paving the way for a future driven by exceptional performance and efficiency. With cutting-edge design, advanced functionalities, and unparalleled reliability, HCLTech's semi-chip services power next-generation electronic devices.