WHITEPAPER

Factory Test Tool
Hardware Verification Solution

Author: Roshan Noronha

L&T Technology Services

L&T Technology Services

Factory Test Tool Hardware Verification Solution

contents

WHITEPAPER

1. Introduction

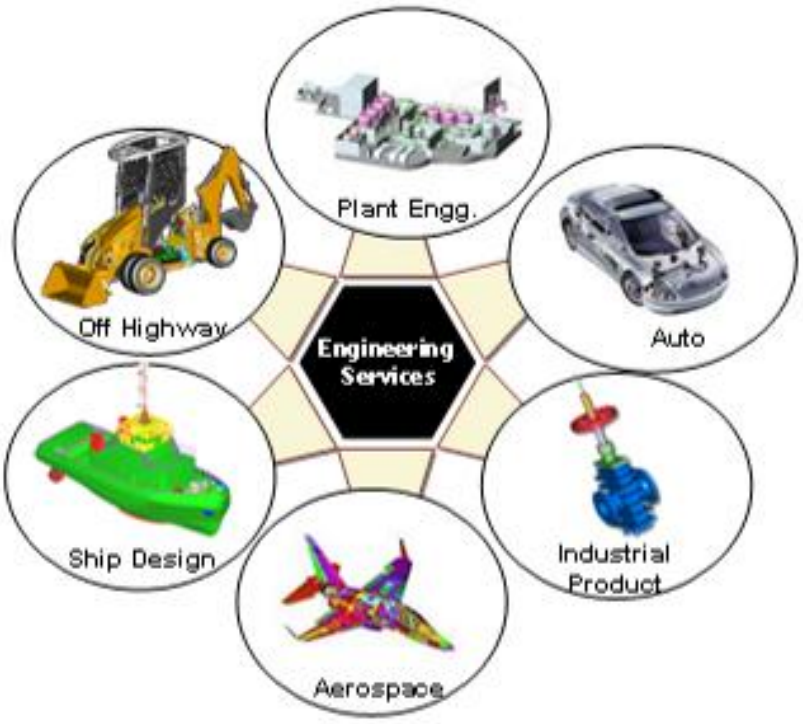
1.1. L&T TECHNOLOGY SERVICES

L&T Technology Services (L&T TS) is a Wholly Owned Subsidiary of Larsen & Toubro Limited coming under IT & Engineering Services Operating Division. L&T TS provides end-to-end engineering services including Product Design, Engineering Analysis, Application Development, Plant Asset Information Management, Plant Engineering and Engineering Process Support using cutting-edge CAD/CAM/CAE technology.

L&T TS operates from dedicated off-shore engineering centers at Bangalore, Chennai and Vadodara in tandem with onsite teams to cater to engineering requirements of global clients, many of them, Fortune 500 Companies.

L&T TS provides engineering solutions covering entire product lifecycle in the domains of Automotive, Aerospace, Off-Highway Equipment, Industrial Products, Marine & Ship Design and Plant Engineering.

L&T TS's credentials include ISO 9001: 2000 for Quality Management System, ISO 27001 Certification for IT Security Management System and process development in line with SEI CMMI Level-5.



1.1.1. Mobile and hi-Tech

Mobile and Hi-Tech Group has the unique background of being part of a very large and technology-rich company: Larsen & Toubro Technology Services Limited. The quality of the solutions and services that we provide reflect the strong background of our state-of-the-art engineering practices. We engage ourselves in the entire Software development Lifecycle through close interaction with various world-class clients from around the world. We add value to our customers through products/tools developed by L&T Technology services and by providing software and hardware services.

One of the value add tool that we have developed indigenously is stated below

2. Factory Test Tool for Hardware Verification

2.1. Concept and Need

Hardware roll out is most significant milestone for every hand-held product. Reaching hardware design maturity early, reduces time to market and further reduces hardware re-iteration cost at factory.

FACTORY TOOL is a proprietary concept designed by L&T Technology Services Engineers, targeted towards comprehensive hardware verification. L&T Technology Services has developed this tool and maintains customized versions of this tool for customers.

FACTORY TOOL is flexible and enables basic and advance Hardware verification with easy to understand result logging facility. Tool has portable architecture and can be easily extended to customized hardware requirements and to leading hardware platforms. It also provides facility to configure hardware which allows factory engineers to test out critical features early, without having final software ready.

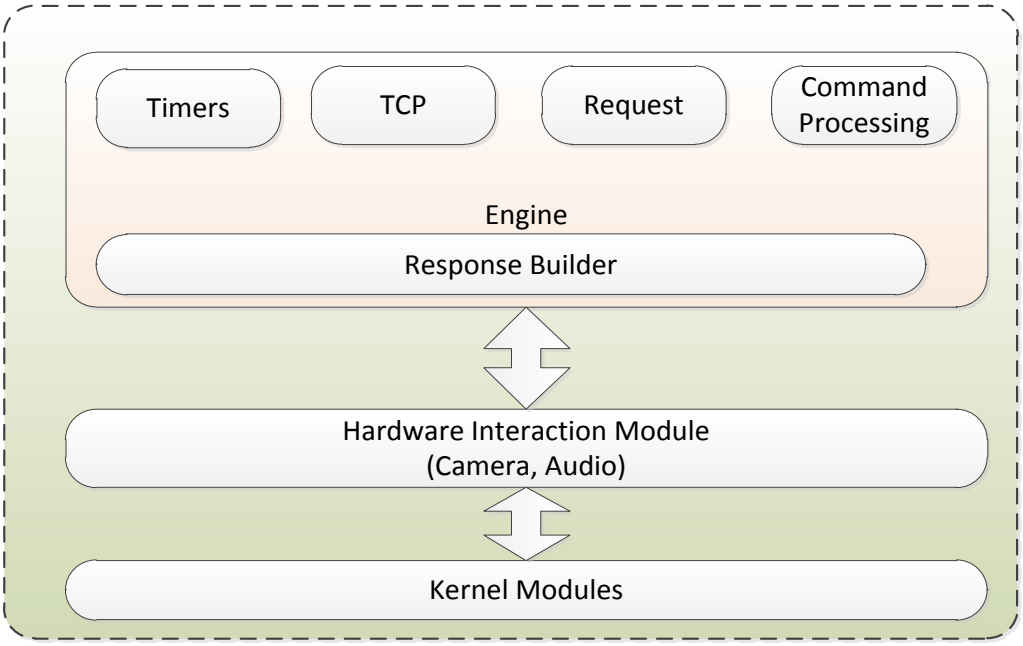
2.2. Tool Overview

Factory Test Commands is a software test tool used during production phase of Smartphone.
It is primarily used to test variety of hardware components on the handset, some of them are stated below

- Camera Sensor and Sensor configuration
- Audio DSP, Audio routing, Hardware Codec modules and accessories
- Sensors (Proximity, Gyroscope, Accelerometer etc.)
- Touch Screen Calibration
- Display Controller
- Wi-Fi Chip
- Bluetooth
- NFC Chip
- Battery bring up and performance
- Reading and Writing Hardware registers
- E-ink display panel

3. Factory Test Tool Software Architecture

Factory Tool engine is designed to have client-server communication model where the Factory Tool engine acts as a server. The key ingredient is the software architecture which segregates hardware details and makes most of the software modules hardware agnostic.



Architecture diagram

3.1. FACTORY TOOL Engine

Factory Tool Engine starts as a daemon process during boot up and listens for the incoming requests. On request it parses the required information to fetch the opcode and request body.

The opcode indicates to which module the request belongs to and depending on the opcode embedded in the request Factory Tool Engine calls the appropriate peripheral handlers (audio, camera, sim, led, etc.) along with the operand.

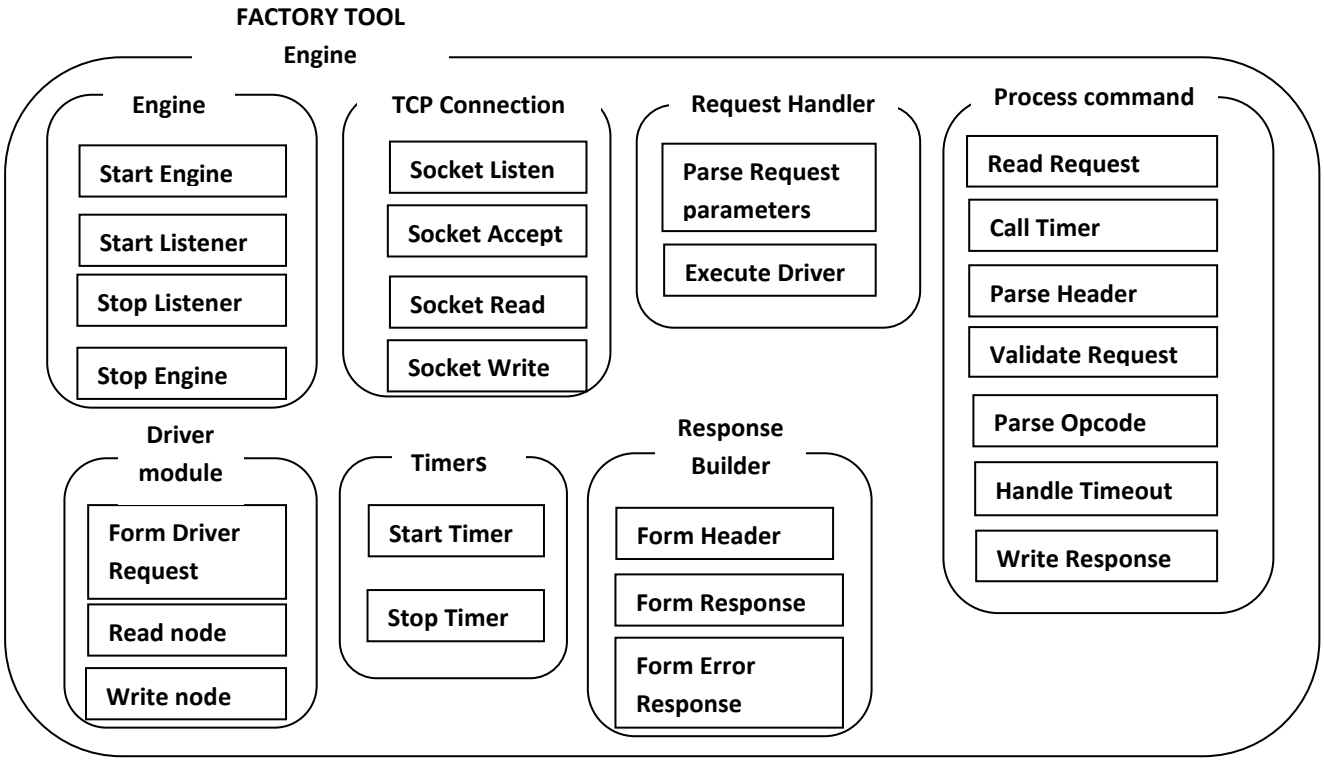
Factory Tool Engine waits for the response (success, error or timeout) which is written to the connected socket.

Each handler parses the request data containing the action to be performed along with the operands necessary for the requested action. Then the request is further passed to the driver module.

The driver module forms the request required by the actual driver and calls the driver api to execute the request.

Modules in Factory Tool Engine:-

- Engine
- TCP Connection
- Request Handler
- Process Command
- Driver Module
- Timers
- Response builder



Block diagram

4. Usability

Hardware verification Engineer can execute the test commands and procedures by using command terminal to verify hardware components e.g. sensors, display, camera etc. which are embedded on a PCB. The test scripts can be designed to validate hardware's overall functionality, perform self-tests and verify communication between master processor and peripherals.

Tool is an automated test suite which independently executes all the test cases depending on the number of modules selected and generates detailed test report which includes successful and failure test cases with appropriate technical reasons.

4.1. Manufacturing Environments

Factory Test Tool is the complete diagnostic solution for Android device manufacturers and assemblers. The tool is designed for the rigorous demands of volume manufacturing or service environments, Factory streamlines processes – from incoming inspection to final systems testing – using industry leading hardware diagnostics and system information tools throughout the full device lifecycle. The tool dramatically improves product quality, and reduces troubleshooting time and repair support costs. It performs fully automate testing of device subassemblies, Verify correct system configuration and Confirms that assembled systems are correctly configured .It ensures products are free of defects before delivery in order to reduce out-of-box-failures.

4.2. Hardware Design Verification

The tool is used by hardware designers to test particular hardware component. It is helpful for Original Design Manufacturer (ODMs) and Original Equipment Manufacturers (OEMs) to calibrate peripherals of device like Touch, Camera, Sensors etc.

4.3. Factory Service/Support Centres

It is critical that the hardware operates reliably. Hardware failures deplete revenues and damage brand reputation.

The tool helps to quickly differentiates hardware problems from software problems and confirms that repaired systems are correctly configured. It ensures repaired systems are free of defects before return to owners and increases customer satisfaction and brand quality.

5. Advantages

Key advantages

- Hardware assembly is the most critical, tedious and time consuming activity in the life cycle of a device. A minor error at this stage can increase the overall time and cost of production. Since “Time to market” is a very critical parameter for a hand held device. This is where the tool comes in handy. It performs validation of all use cases related to hardware and can help diagnose any faults at the very early stage of production.
- Portable Software architecture
- Provides capability to dynamically configure hardware parameters and calibration of peripherals
- It helps to test overall functionality of core components Camera, Battery, Audio, Charger, Vibrator, Power Management etc.
- It performs all the unit test cases related to hardware and can help to diagnose any faults/ hardware connection error at the very early stage of production.
- The tool also helps to modify and configure phone parameters like IMEI number, Phone model etc.
- The tool needs no UI works as standalone module on a handset
- The tool helps in calibrating Camera and Touch modules
- Provides module selection option to test selective components
- It provides complete details of test case failure reason in generated test report on execution

6. Business Impact

Due to modular design of the tool, 80% of the software code can leveraged with hardware specific upgrades for different chipset vendors thus reducing efforts, cost and time to customer.

7. Summary

The low cost Factory test tool is complete end to end solution to test each component of the embedded device during development & production stages. Software design makes it scalable to any type of hardware platform.