

**ARE WE READY FOR THE NEXT
INDUSTRY REVOLUTION?**

TELECOM, CONSUMER ELECTRONICS AND SEMICONDUCTOR

Industry Overview: Reshaping the Market

In 2016, the telecommunications industry continued to evolve in innovative ways. Operators continue to seek differentiation through network quality and breadth of service portfolio. The need to keep up with new technologies to support data needs in the gigabit era has become paramount. Innovation rates are only likely to rise between 2016 and 2020. The smartphone revolution and the resulting birth of OTT platforms have created new catalysts for innovation that touch all verticals.

Similarly, the Consumer Electronics and the Semiconductor industry is thriving on innovation and constant technological advancement. Creating robust business models and investing in next-gen technologies will be the key focus areas for the consumer electronics industry today. According to Semiconductor Industry Association, the 2016 global chip market is set to grow 0.3 percent compared with 2015 to reach a value of \$341.0 billion.

Some key trends shaping the industry:

Network experience: Providing a basic high-speed network experience will be a priority for the telcos in near future. Differentiated customer service experience will no longer be a dominant criterion for operator selection by customers.

Enhanced regulator focus and scrutiny on network quality: Higher levels of transparency and accountability in ensuring network quality will be the main driving factor to shape the telecom industry.

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IoT: The next major trend is the explosion of connected devices. This will add billions of new connected data sources globally by 2020. The upswing of all of these devices will be an astronomical growth in data volumes; we will quickly push through exabyte volumes and enter the world of zettabytes per year.

5G for Semiconductors: Virtual reality, intelligent cars and highways, and over 40 billion sensors monitoring everything in the connected world – this predicted future will only compound semiconductor demand further.

Smarter CES: From smarter wearables, connected home tech, cars to virtual reality games and drones – Rapidly changing customer choices make this industry highly competitive.

Preparing for the Future:

Carriers would need to shift their focus on providing data and voice services that are high quality, reliable, and affordable in a market where there is increasing usage, declining rates and scarce spectrum.

The rapid evolution of technology and the speed of engineering innovations are intertwined, making it challenging for Telecom players to keep pace.

Partner in your Success: L&T Technology Services

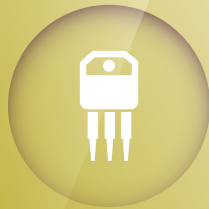
We help you build and deploy innovative solutions that enable you to harness and leverage dramatic changes in the marketplace to your advantage. Our in-depth industry knowledge and technology expertise, coupled with our dedicated delivery centres ensure that we render strategic business value to various Telecom ecosystem players like OEMs/ODMs, carriers, chipset makers and ISVs.

WINNING SOLUTIONS

Our expertise span across Media & Entertainment, Network Infrastructure, Mobile Devices, and Storage & Computing. Our team of 2000+ domain and technology experts with over 15 years of experience, offer diverse vertical domain know-how and broad technology platform competencies. With a strong focus on wireless technologies through ready skills and experience, we offer services ranging from product conceptualization to sustenance. Our demonstrated leadership in LTE and Android technologies and deep involvement in emerging technologies like M2M and IoT have enabled our clients to accrue operational and business benefits.



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SEMICONDUCTOR

- // Design & Development
- // Product Life Cycle Services
- // Porting & Performance Optimization
- // Testing and Test Automation
- // Deployment & Integration
- // Operations
- // Board Design
- // PCB Design
- // Firmware
- // RF
- // FPGA
- // RTL2GDSII
- // Complete Ownership Model



CONSUMER ELECTRONICS

- // Smartphones & Tablets
- // Enterprise Devices
- // Wearable Devices
- // M2M
- // Non-Handheld Devices
- // Set Top Box & Digital TV
- // Residential Gateway
- // Connected Home
- // In-Flight Entertainment / Infotainment
- // Video Head-end



TELECOM

- // Wireless Networks
- // Data Networks & NGN
- // Enterprise Solutions
- // Virtualization
- // Cloud & Network
- // Management

Testing:

Test Tools | Framework Development | Automation
| Interop/Pre-Certification Test Consultancy

VLSI design:

Modeling | Physical Design | DFT | Verification |
Validation | Foundry Support

Application Services:

Apps | UI | UX | Digital Transformation | IoT/M2M

System Integration Services:

Communication & Connectivity | Video Surveillance
| Smart Building Management | Smart Energy
Management | Digital Signage Management

CONSUMER ELECTRONICS

L&T Technology Services has extensive experience in working with leading OEMs, technology providers, operators and Broadcasters on developing and deploying products and services for the broadcast and home networking ecosystems.

Our specialized team of 500+ engineers are domain experts and have competent experience in broadcast ecosystem for Set Top Box & Digital TV, Residential Gateway, Home Networking and Video Head-end equipment.

FOCUS AREAS

CPE (Set Top Box, Residential Gateway)

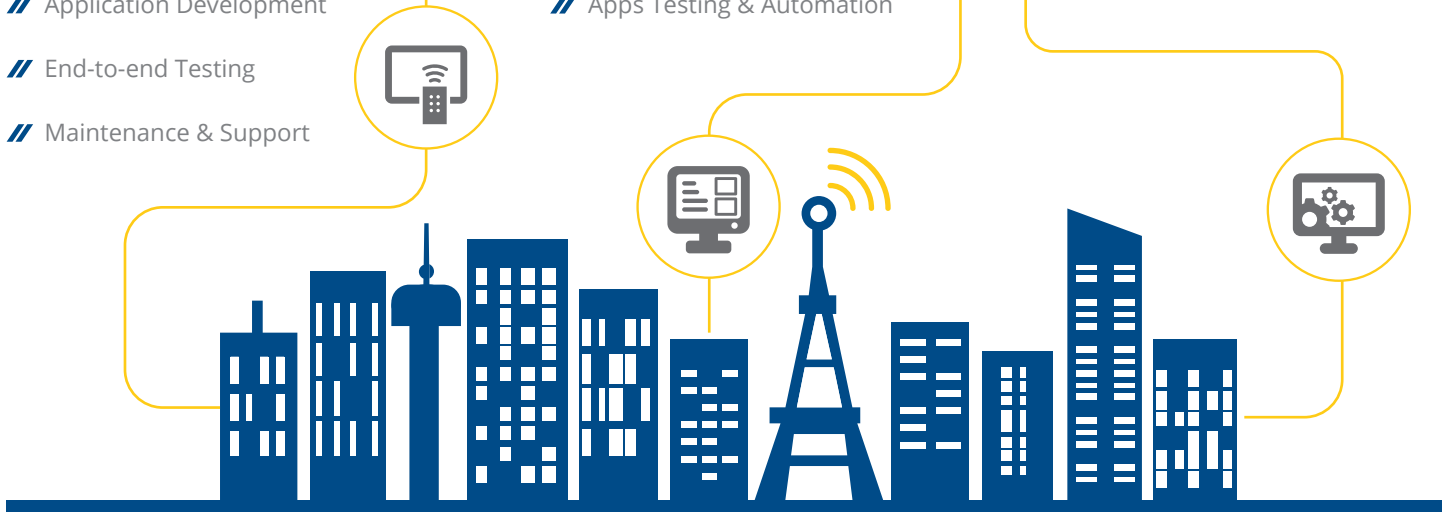
- // Product Design, Reference Design
- // Product Integration
- // Middleware Development & Porting
- // Application Development
- // End-to-end Testing
- // Maintenance & Support

Broadcast & Home Networking Apps

- // End-to-end (Client-Server) Applications
- // Companion Device Apps (Android, iOS)
- // HTML5 Multiscreen Apps
- // Apps Testing & Automation

Headend Systems

- // VoD Server Integration & Configuration
- // Multiscreen Streaming Server
- // Ad Insertion Solution Development and Integration



Our broadcast ecosystem offerings encompass STB/RG/CPE applications, middleware, testing & product design; android & iOS applications for TV, home networking, home automation; and system integration & solutions for video head-end and broadcast/broadband network. The following are some of our solutions which enable accelerated device and service deployment.

RDK Emulator: Includes the emulation of tuning (for QAM), de-multiplexing, decoding and displaying the decoded content of the audio/video data.

TR-069 Client Solution: Component based on CPE WAN Management Protocol endorsed by Broadband Forum.

DLNA Stack: Component based on DLNA guidelines that can be easily integrated with home networking and mobile handheld devices like STB, RG, modems, mobile phones, PDA, etc.

STB Test Automation Tool (DTRobo™—STB): A framework that executes test automation scripts on the device and captures results in a structured format.

Advertisement Decision Manager: An Ad Insertion Manager based on SCTE specifications, to integrate Ad Insertion flow from content stream, Ad Decision Servers and Ad Content Server to Splicer.

Smart Media Controller: Server and client-side solution with no network dependency to stream OTT content over devices of different screen size and resolution.

Cloud STB Solution: Services for deployment in Cloud and client side framework for Middleware integration and supporting Cloud.

TELECOM

We address the complete communication value chain (Wireless & Wireline) comprising access, transport and core networks, along with service enablement for telecom networks.

Backed by 2000 man years of competent experience, our services encompass trending

areas of small cell, VoLTE, NFV, SDN, VoIP, WLAN, Network Management, WebRTC, Connectivity Solutions and Network Engineering. We offer an entire suite of network infrastructure service offerings ranging from software development for NEMs, hardware platform design & development, testing, to product maintenance & sustenance.

Offerings:

- Wireless N/W - 5G, 4G-LTE, WCDMA, GSM, WLAN
- Data Networks & NGN - Routing / Switching, Metro/Carrier Ethernet, SDN, NFV, Security, Soft-Switch, Media Gateways
- Enterprise Solutions - IMS, WebRTC, SIP, VoIP, VoLTE
- Network Management - NMS / EMS, LTE-SON, OSS/BSS

Solutions:

- LTE UE Stack - Rel. 8 Compliant, ready to deploy
- vEPC - SGW, PGW & MME
- vRouter - Soft Router based on FreeBSD and Quagga
- LTE-WiFi CPE Gateway reference design - Highly flexible/customizable design for multiple form factors & use cases
- SDN Conformance Test Suite - OpenFlow Conformance
- Software Defined Network Monitoring and Control Application - Controller Independent | Monitoring & Policy Management
- WebRTCTest Bed - OpenIMS based testlab setup made for IMS calls POC and VoLTE call POC | WebRTC Gateway



SEMICONDUCTOR

We have a strong presence in the mobile ecosystem based on decade-old relationships with tier-1 OEMs, chip vendors, operators and ISVs, backed by an expert team of 900+ engineers. Our expertise cuts across multiple mobile OSs and services extending right from designing and development to testing and sustenance. We are a member of Open Handset Alliance and an Android Commercialization Partner for leading OEMs and platform vendors.

Solutions:



Bluetooth Low Energy (BLE) – Find Me Profile:

- /// BLE marketed as Bluetooth Smart, is a WPAN technology designed and marketed by the Bluetooth SIG
- /// Developed Locator and target profiles for Find Me Profile
- /// Tested on BlueZ: 5.19 Stack using ARM based platform running Linux 3.10



Wearable Smart Watch:

- /// Comprehensive reference design (HW, Mechanical, Firmware and applications) for quick time-to-market
- /// Features supported: Heart rate & fitness monitoring, V2T, Sleep Tracker, fall detection and alert and utility applications
- /// Apps for wearable devices



Data Analytics:

- /// Intellipreter – Splunk App for Android device log analytics



DTRobo Android Test Automation Suite:

- /// Automation framework to test Android devices
- /// Features automated: System Test, Bluetooth Automation, Performance Test, Current Drain

TECHNOLOGY ALLIANCES

We redefine strategic imperatives for client business by building a synergistic relationship with our partners. Our network of alliance partners enables us to deliver to our clients, a competitive business value driven by collaboration, executive commitment and thought leadership.



Some of our Key Alliances:

- RDKASP/MSP Member
- Member of Frog Ecosystem by Wyplay
- Ecosystem Partner for RDK
- Digital Living Network Alliance (DLNA) Member
- Ericsson Mediaroom Development Partner
- Open Handset Alliance Member
- Android Commercialization Partner for Texas Instruments
- Splunk Powered Referral Partnership
- Freescale Design Partner
- Microsoft – Gold Certified & Windows Embedded Partner
- Oracle Partner Network
- Intel Network Builders Program
- ETSI Participating Member
- HP One Alliance Program
- Cisco Collaboration for IoT Solutions
- Tele2 Alliance for M2M, IoT Solutions
- Sierra Wireless Collaboration for IoT Solutions
- Qualcomm's IoE Ecosystem Partner (Authorized Design Center)
- ThingWorx Partner Program for IoT and M2M
- Redknee Partnership for Connectivity, Analytics and Monetization for IoT

LAB INFRASTRUCTURE

Our dedicated competency group delivers tangible business results and new efficiencies to our clients. Equipped with state-of-the-art infrastructure, our customer-centric and metrics-driven labs provide an environment for sophisticated research in cutting-edge business solutions.

Telecom & Hi-Tech Solutions Lab: This is a dedicated lab to showcase prototype solutions developed in-house for current as well as futuristic technological trends. The lab housing solutions spanning from Proof-of-Concept (PoC) to matured, and go-to-market solutions is available for live demo for our prospective clients and visitors.

STB Cable Head-end Lab: This is a dedicated lab set up with customer-owned equipment used for customer-specific programs, and has the latest video infrastructure such as Head-ends, Modulators, Streamers and Multituner Set Top Boxes.

Home Networking Lab: This is equipped with DLNA compliant devices, Wi-Fi, TV sets, and development boards.

FDD LTE Test Lab: This is a complete set-up for chipset, UE & eNodeB end-to-end testing and validation. Supporting major bands such as 12, 17 & 4 based on leading carrier requirements, the lab can be scaled for new features and bands as per new requirements.

Wi-Fi Test Lab: This is an enterprise grade Wi-Fi lab with multivendor equipment such as APs, Stations, Controller, and Sniffer tools.

STB Test Automation Lab: Our STB test automation lab offers a one-stop scalable solution to automate testing of STB applications. Housing Satellite, Cable, IP STBs; Video Capture and IR Blaster tool - the test automation lab is a key competitive advantage to our clients.

IoT Labs: Our Internet of Things lab in collaboration with Cisco focuses on creating joint IoT solutions. Another lab dedicated to Sierra Legato Platform-based IoT solutions uses various Sierra Wireless hardware and modules.

CE Experience Centre: Consumer Electronics Experience Centre with demo setup to showcase application areas in L&T Technology Services' Consumer Electronics portfolio like home networking and automation, mobile and wearable devices etc.

Smart Home Experience Centre: Showcases demos in Smart Home space.

Besides the above, we also have dedicated lab set-ups for LTE core and RAN, SDN, VNFs — vRouter & vEPC, Network Management, IMS core & VoLTE, RF, and EMI/EMC.

CASE STUDIES

Created world's first dual-screen smartphone. Recognized as the hottest mobile devices in CES 2014. One-of-a-kind android phone with e-ink reader - L&T Technology Services was involved in complete software development, platform software design, development, and testing for the android phone.

Developed a Next-Gen STB with Multi-Tuner Support. The next-gen cable STB with 8 Tuners and UI applications like EPG, DVR, RDVR, MR-DVR, PPV, SDN, VoD along with integration with 3rd party apps. Used Agile/Scrum based approach with predominant offshore implementation (>85%).

Provided support activities for a leading OEMs TD-LTE eNodeB. Significant reduction in the turnaround time and 85% CQs resolved during transition across multiple modules.

THE WINNING EDGE

We have been recognized by various industry bodies, research organizations and clients. Some of our key recognitions and certifications:

Consistently ranked in the “Leadership Position” among Telecom Engineering Service Providers, by Zinnov*.

Certification:

// PMP/IPM certified Project Managers



QUALITY FOCUS

Our comprehensive Quality Management System (QMS) provides a robust framework for global delivery. It factors in the varied nature of our engagements across industries and domains including engineering solutions for CAD/CAM/CAE/PDM and other customization services, plant engineering solutions, design and engineering services, product engineering and application software services, independent testing & test automation services, and test systems development.

Our process improvement initiatives are driven with the help of a measurement framework and the support of our compliance testing labs across various industry verticals. Process performance models govern our key delivery processes, which helps us predict performance and proactively take actions on our projects. An independent and dedicated quality team, supported by senior management, is focused on driving the quality movement throughout the organization. A cross-functional task force focuses on continuously improving the efficacy of our quality systems.

// ISO 9001:2008 certified delivery centres: Only companies that demonstrate its ability to consistently provide product that meets customer and applicable statutory and regulatory requirements get this certification.

// Our Aerospace and Medical Devices practices are AS 9100C and ISO 13485:2003 certified. The certification upholds the quality and system requirements that L&T Technology Services incorporates in its management systems.

// Embedded systems and software activities are assessed at Maturity Level 5 of SEI's CMMi® Development Ver. 1.3. – signifying high standard of consistency in performance and delivery.

// We have bagged the Quality Excellence Award for Planning, Processes & Systems at the World Quality Congress in 2014/15.



INNOVATION CULTURE

Our Culture of Innovation has enabled us to grow and retain our customer relationships and successfully achieve process and productivity improvement for customers.

Deeply passionate and perennially curious, the need to create is a true phenomenon at L&T Technology Services. Innovation as a practice dominates both our value-centric and customer-centric approach to solutions. We continuously innovate to make engineering solutions leaner and less complex.

Our presence across multiple industry segments enables cross-pollination of ideas that lead to product, process, and technology innovations. This innovation culture is further nurtured through investments in a dedicated innovation lab to incubate ideas and transform them into reality. We understand the role of continuous improvement and thus make innovation a practice to deliver distinguished engineering solutions.

We focus on innovation driven technology leadership and have set up research and test laboratories that are specific to industry verticals. Our 31 laboratories replicate our customers’ work environment.

We also work closely with international and national scientific institutions to continually source ideas for engineering solutions. Our events such as Tech Panorama, which is an initiative by the Technology Solutions and Innovation Centre within our company, serve as a platform for our employees to showcase their skill and demonstrate ideas.

Own Patents	37
Co-Authored Patents	137

L&T Technology Services - Telecom, Consumer Electronics & Semiconductor Industry Vertical

The L&T Technology Services' Telecom, Consumer Electronics & Semiconductor Industry vertical provides Engineering, Research & Development Services for leading global companies. The vertical works across the industry value chain from material to maintenance.

L&T TECHNOLOGY SERVICES

The important thing is not to stop questioning. Curiosity has its own reason for existing," said Albert Einstein.

We couldn't agree more...

That's what we do:

IMAGINE: Possibilities for enriched products, services and life...

EXPLORE: Ingenious and innovative ways for a sustainable future

DELIVER: Top quality solutions leveraging the 75-year old rich legacy and engineering heritage of our parent company Larsen & Toubro

We offer design and development solutions throughout the entire product development chain across various industries such as Industrial Products, Medical Devices, Transportation, Telecom, Consumer Electronics and Semiconductors and Process Engineering, besides Mechanical Engineering Services, Embedded System Services, Product Life Cycle Management (PLM), Engineering Analytics and Power Electronics and Machine-to-Machine (M2M) and the Internet of Things (IoT).

Today, 37 own and 137 co-authored patents later, our 8000+ engineering specialists continue to solve business problems for 170+ customers, including 50+ Fortune 500 companies. With presence in 16 countries, 12 Global Delivery Centers and 27 Sales Offices, we continue to dominate the Engineering, Research and Development (ER&D) space, globally.



L&T Technology Services

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