MindTree Device Engineering Services

August 2011
Device Engineering Services Offering

**Engineering Services**
- Design & Development
- Maintenance & Sustenance
- Verification & Validation
- Professional Services
- Product Support

**Domain Expertise**
- Software Excellence
- Lab Infrastructure
- Product Testing Capability

**Mobile Phone**
- Phone Software development
- Version upgrade
- Carrier customization

**Infotainment**
- Navigation devices
- Portable Products
- Set-top Box
- Digital TV

**Automotive**
- Infotainment and Telematics
- Diagnostics and Inspection
- ECU Software
Product Segments in focus

**Android**
- Android Platform/Kernel
- Android Middleware – Multimedia, Sensor Networks, Connectivity
- Applications – Application Management Systems, UI development, Multimedia applications

**Smart Phones**
- Smart phone platforms – Android, iPhone, Blackberry, Windows, etc.
- End-to-end phone design
- Usability analysis, UI design
- Application development

**Connectivity**
- BlueTooth
- WiFi/WLAN
- NFC, ZigBee
- GPS, LBS
- Stack Development/Integration
- Application development

**Tablets & Personal Infotainment**
- Unified communication devices
- Media players
- Multimedia Applications

**Smart TV**
- Internet TV
- Content Navigation

**Automotive Infotainment**
- Navigation Devices
- Media Players
End-To-End Phone Engineering Capabilities

**Requirement**
- Global + Local Design Concepts
- Phone + App Interaction Design
- Usability & Focused Group Feedback

**Carriers**
- Carrier customization
- Certifications
- IOT and field debugging

**Software implementation**
- Complete Software stack expertise: Base port till Application
- Platforms: Android (Linux), BREW

**Manufacturing**
- SCM, Manufacturing support
- FOB, FL, RL, CCO, Service mgmt

**Prototype**
- Global + Local Design Concepts
- Concept to Product
- Rapid Prototyping

**Product management**
- Product definition
- Product P&L
- Requirement Management
- Technology Management

**3rd party integration**
- Integration of 3rd party Libs/solutions
- Customization and enhancements Support factory

**Product Quality**
- Product testing: Application, Radio technology, Customer requirements, compliance and interoperability
- DVT, CT
- DFMECA

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**100+ PHONE MODELS**

**50+ CARRIER CERTIFICATIONS**

**45+ MILLION PHONES IN THE MARKET**

**Geography:** NA, Canada, India and LATAM
Accomplishments

- Delivered the first complete phone (end to end) from India to the globe
- Partial to full engineering of 50+ phone targets for 50+ carriers
- Testing and Validation of 100+ phone targets for 50+ carriers
- Partial to full engineering of 45+ million phones in the world market
- Co-Engineered the world’s first CDMA + Wi-Fi dual mode phone
- Co-development of world’s first CDMA-NFC phone
- Won industrial design projects against some of the best ID teams in world including IDEO and BMW Design
- Developed the smallest foot-print 802.11a/b MAC firmware.
- Bluetooth – Leadership position as an independent Bluetooth IP and Engineering service provider. 5% of worldwide Bluetooth shipments carry MindTree IP – either at silicon or software level.
### Product Lifecycle: Track Record

<table>
<thead>
<tr>
<th>Client</th>
<th>Areas Of Work</th>
<th>Version Upgrade</th>
<th>Peripherals Integration</th>
<th>Application Development</th>
<th>UI Development</th>
<th>Frameworks/Platform</th>
</tr>
</thead>
<tbody>
<tr>
<td>Korean Phone vendor</td>
<td>Version Upgrades, Port changes, Application Development</td>
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<tr>
<td>European Navigation device vendor</td>
<td>Test Framework Development, Platform Development</td>
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<tr>
<td>European Solar vendor</td>
<td>Complete product development</td>
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<tr>
<td>US Based semicon vendor</td>
<td>WLAN, BT, FM, GPS – Integration, Porting</td>
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<tr>
<td>China based telecom company</td>
<td>Applications development</td>
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</table>

**Commercial Grade Products Developed**

![Commercial Grade Products Developed](image)
Android Services Offering: Overview

- Developing custom applications
  - Carrier customization

- Enhancement/Customization of framework layer

- Customization/Integration libraries

- Integration with target hardware

- Testing and test automation
Frameworks & Applications
- Application Management Systems
- UI Framework Components
- UI centric Applications
- Multimedia applications
- PIM/Email/ SMS/Browser
- Home Screen

- Integrated Nuance Xt9 IME solution
- Search engine development
- Upgraded contacts application to aggregate social networking sites
- Gallery and home screen customization
- Added V-card to BT OPP profile in Eclairs
- Enhanced webkit based full HTML browser, to support multiple selection of bookmarks; text selection in browser

Middleware
- Audio, Video Codecs
- Camera
- Telephony
- Bluetooth, Wi-Fi
- GPS, FM
- Video Conferencing

- Connectivity solutions – Bluetooth, FM, WiFi, GPS
- Integrated DLNA
- Integrated of Zigbee profiles
- Integrated PJSIP open source SIP in Froyo
- Implementation of 2-way RTP and integration with Stagefright
- Integration and validation of hardware accelerated codecs
- Implementation of PAN profile of Bluetooth
- Development of RIL channel for a-GPS AT commands

Android Kernel
- Platform Base Port
- Platform commercialization
- BlueZ
- Audio
- Sensors
- Power Management

- Board bring-up of a mobile phone production board with OMAP3430 application processor and STE cellular modem
- Customization of boot loader and kernel
- Device driver development & Porting
- Stability validation using LTP
- Validation of power management and charging
- Audio and sensor calibration
Carrier customization: Expertise and offerings

Requirement
- Understanding Human factor engineering needs system engineering requirements
- Collaborate and create the carrier specific detailed user requirement spec
- Create Wireframes and interaction flows and design specifications for developers’ use
- Create UI prototypes and actual graphics.

Implementation
- Complete software delivery for major tier 2 carriers
- Rapid customizations for each carrier
- Development of specific features eg. Security features like USB lock, NV Access, service programming etc.
- Quickly integrate third party software solutions (Email, IM, Calendar etc.)

Deployment
- Testing of the complete phone software at MTW
- Responsible for certifications at various certifying labs
- Support Lab testing at Carrier labs and for user trials

BADGE: PROVIDE YOUR CUSTOMER AND YOUR COMPANY'S LOGOS HERE (Optional)
**Device Testing**

### Feature Testing
- Messaging
- Call Processing
- System Determination
- GPS / LBS
- Audio
- Bluetooth
- Accessories
- Data services
- Multimedia
- Tools
- Pre

### Pre / Certification
- Bluetooth BQB
- CTIA
- CDG 1/2
- CCF
- SFN

### Field Testing & customer acceptance
- VMU
- Metro PCS
- Cricket
- Cox
- Indian Carriers
- LATAM carriers

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**Complete CDMA phone QA**

- Feature Testing (UI, functionality/protocol testing, Exploratory/ad-hoc testing)
- Certification for the products -Pre-certification tests & working with the external labs for final certification (Bluetooth BQB, CTIA, CDG1, CDG2)
- Field tests & customer acceptance
INDUSTRIAL DESIGN

Device Management:
- OMA-DM and FOTA capable

Memory
- 256 MB RAM and 512 MB ROM
- microSD up to 32 GB

Battery
- 1300 mAh Lithium-Ion

Audio:
- Dual Microphone noise suppression
- HAC & TTY Compliance
- 3.5 mm HSJ, Speakerphone
- 24 bit Audio

Connectivity:
- Bluetooth (2.1 + EDR) w/ HFP, HSP, A2DP, AVRCP, PAN, PBAP, & OPP
- Wi-Fi (802.11b,g), GPS

Media Player & Gallery-Integrated client:
- Video Playback: HD (720p) 30fps MPEG4 & H.264
- Video Record: 720 x 480 30fps
- Image Viewer: jpg, etc w/editing features
- Music: AAC, MP3 and Midi Ringtones

OS
- Android 2.1 (Éclair)

USP:
- OMNI, Quiver, Rainbow, Meadow

Modem Technology
- WCDMA/HSPA Rel. 6 - 850/1900/2100 MHz
- GSM/GPRS/EDGE - 850/900/1800/1900MHz

Processor
- 720 MHz OMAP 3430 (upgradable to 3630 1GHz)

Display & Touchpanel
- WVGA 3.5’ (800 x 480)
- TFT capacitive glass
- Capacitive Multi-touch

Memory
- 256 MB RAM and 512 MB ROM
- microSD up to 32 GB

Battery
- 1300 mAh Lithium-Ion

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Android Based POS Device

RETAILER CONNECT TERMINAL

- POS terminal with biometric sensor
- Connectivity interfaces: USB, HDMI, Wi-Fi & GSM
- Available devices: Thermal printer (in built), External Bar Code Scanner, LCD Monitor & other serial or USB devices on need basis
- Smaller form factor is also available
- Rugged and functions in dusty environment
- Easy to use for Semi-literates
**BT Connectivity**

**Development and maintenance of BT Stack and profiles for a semiconductor vendor**

### Objectives

- Integration of Bluetooth with the platform and OS power management framework
- Develop/Optimize UART transport drivers for Bluetooth
- Implementation of Shared Transport Driver

### Solution

- Integration of Bluez Bluetooth stack with Bluetooth chipset
- Implementation of adaptation layers to integrate phone UI [Bluetooth Specific], and applications (Bluetooth stack) with Bluetooth chipset.
- Development of middleware to enable wireless audio streaming (A2DP/AVRCP) and voice call (HFP/HSP) and integration with multi-media and platform
- Implementation of audio policy and routing framework
- Interoperability Testing
- Implementation of HID and PAN profile support in Android

### Platform & Technology

- Android 2.1, 2.2, 2.3 and 3.0
- BlueZ for different versions
- PTS Test suite
## GPS Host Solution on Android

<table>
<thead>
<tr>
<th>Objectives</th>
<th>Solution</th>
</tr>
</thead>
</table>
| ● Porting of GPS Host software  
● Development of Android Adaptation Layer for GPS Host SW  
● Implementation of SUPL on Android.  
● Implementation of control plane for emergency calls (E911) | ● Support Autonomous GPS and Assisted GPS (A-GPS) solution which is portable across different OS and HW platforms.  
● A-GPS SUPL solution tested with 3rd party real SUPL server and ULTS.  
● Modem integration for control plane support.  
● Support SUPL A-GPS functionality for set initiated and network initiated mode.  
● Reduced the Time To First Fix (TIFF) for Autonomous GPS and A-GPS as per the requirement set by customer. |

### Tools and Technology
- Android 2.1, 2.2, 2.3, 3.0
- 3rd party SUPL servers and ULTS
Wi-Fi Solution

Development and maintenance of Wifi Stack and driver for a semiconductor vendor

Objectives

- Porting of WLAN transport drivers (SDIO and SPI) to host platform
- Maintenance of WiFi stack and transport drivers
- Power management support
- Throughput optimization

Tools and Technology

- Android 2.1, 2.2, 2.3, 3.0
- Android CTS
- iPerf, wireshark

Solution

- SDIO driver Optimization
  - Block mode transfer – buffering the packets and sending them in bulk to save on the wake up due to SDIO Transaction-Finished Interrupt.
  - Changing the SDIO transfer from a purely DMA based solution to a combination of copy by Polling and DMA -based on block size.

- Browser Optimization
  - Load balancing by decoding the JPEG images on ARM and DSP decoders based on the JPEG image size.
  - Increasing the number of concurrent http connections to improve the background download time.
  - Increasing the number of concurrent background threads to improve the overall browser experience.
  - Making use of DVFS (spiking the CPU Frequency temporarily) when a browser activity is detected.
FM Solution

Development and maintenance of FM Solution for a semiconductor vendor

Objectives

- Implementation of FM Transmit solution on Android and integrating FM solution with Android Audio Framework.
- Implementation FM V4L2 driver

Solution

- Enhance the FM radio (and FM Transmit) to handle various media scenarios along with FM radio playback like notification, voice call, alarm, and media playback
- Enhanced Android Audio Framework layer (AudioService, AudioManager, and Audioflinger) and Audio HAL for FM radio.
- Dynamic switching between FM radio (or FM Transmit) playback and other Android media services.
- Dynamic switching of FM audio between speaker and wired headset.

Tools and Technology

- Android 2.1, 2.2, 2.3 and 3.0
- Android CTS
ZigBee Application and Profiles on Android

- Development of Android Application, JNI layer – for Home Automation and Smart Energy
- Integration of ZigBee Application profiles on Android
- End to end debugging of the stack

OMAP 4 based TI platform (Blaze)

Home Automation Eval board

Energy meter Eval board
RF4CE on Android

- **Application**
  - Development of Android Application, JNI layer – for RF4CE
  - Integration of ZigBee Application profiles on Android
  - End to end debugging of the stack

- **JNI Layer**

- **RF4CE Stack and Profiles**

OMAP 4 based TI platform (Blaze)

Media Controls

CC2531
## Video Conferencing Solution

### Objectives
- Develop 2-way HD video conferencing application based on SIP
- Add IP Communication middleware in Android

### Solution
- Implement RTP, RTCP and SIP protocols in Android 2.2 (Froyo)
- Enhance Stagefright
- Implement OpenMax G.729ab speech codec
- Port SIP on Android and create a new JNI
- Android 2.2 (Froyo) running on OMAP3630
- Re-use video codec provided by TI OMAP

### Platform & Technology
- Android SDK for 2.1 and 2.2
- NDK 1.5
- Android compatibility test suite
- 3\textsuperscript{rd} Party tools
## Mobile DLNA Solution (M-DMS and M-DMC)

### DLNA Porting and application development for US Based Semiconductor vendor

<table>
<thead>
<tr>
<th>Objectives</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Porting of DLNA stack from Linux</td>
<td>- Development of JNI layers to integrate the DLNA stack (Implemented in C).</td>
</tr>
<tr>
<td>- Development of controller and configuration applications.</td>
<td>- Ported associated UPNP stack. Resolved multiple issues related to threading, synchronization and Bionic libc compliance.</td>
</tr>
<tr>
<td>- Enhancement of DLNA Server and controller profiles for DLNA 1.5 compliance</td>
<td>- Interoperability testing. (Participation in plugfests)</td>
</tr>
<tr>
<td>- DLNA stack qualification for M-DMS and M-DMC</td>
<td>- Tested with Conformance test tool (CTT Version 1.5.00.56)</td>
</tr>
</tbody>
</table>

### Platform & Technology

- Android 2.1 and 2.2 (NDK 1.5)
- DLNA 1.5
- CTT 1.5.00.56
- 2-Box Push (Push Controller)
- 3-Box Push
## Test Automation Framework

### Test automation framework for Europe based navigation services vendor

#### Objectives
- Development of automation test framework to
  - Reduce repetitive manual testing
  - Provide a good scaffolding infrastructure for Test Driven Development
- Ability to run and report test results on every build to ensure better build quality

#### Tools & Technology
- Android SDK 2.2, 2.3
- Robotium test suite
- ANT, JUNIT
- Android compatibility test suite
- 3rd Party tools

#### Solution
- Robotium based test case suites to test the UI and functional flow.
- Used ANT as the tool to trigger the test cases.
- 3rd party tool to output JUNIT compliant output which could be consumed by the CI tool, Quickbuild to produce HTML test results.
- Developed infrastructure for “Closed-loop” automation
- Uses Android Test & Instrumentation Framework along with PC-based components for controlling supporting 3rd party devices
- Test Automation customization for
  - Bluetooth
  - Custom Multimedia Application
  - Parts of Audio
Sunny Portal Android Application

Scope

- Built an Android Application to display the consumption of data from its various Solar plants as replica of iPhone Application.
- The application allows a personalized access to the user for the plants of his choice.
- The user can access various data about the plant such as device information, energy and power data

Problem Statement

- Interface with Sunny Portal RESTful webservice for the Android application development.
- The Sunny Portal on Android will enable the user to consume the following information
  - Data about Device and System.
  - Process data such as CO2 avoidance, Supply, current and voltage, Sensor data etc
  - Device Data and User Data

Our Solution

- The application has two modes. The demo mode and the user mode; The demo mode will provide a list of public installations of SMA. The Demo mode will have a slide show of the features provided by the Android application
- The application has option to view chart/table, tabbed interface which allows viewing the data for different periods of interest such as day, week, month or year.
- The application also provides device(Inverters) details, device description and device status to user.
- The Application provides Multi Lingual support. Currently support English and German.

Key Achievement

- Completed the project on time to meet the customer's internal roadmap.
- The Quality of the project was at par the iPhone application and ready to launch in Android Market.

Challenges

- Understanding the Requirement from existing iPhone Application.
- Replicate the Application functionalities similar to iPhone.
- Meet the Project Quality and Performance to make it ready to launch in the Android Market immediately after completion of development.
Our Mission

Successful Customers

Happy People

Innovative Solutions