MindTree Device Engineering Services

August 2011

Device Engineering Services Offering

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

Domain Expertise

Software Excellence

Lab Infrastructure

Product Testing Capability

Engineering Services

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

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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

Prototype
• Global + Local Design Concepts
• Concept to Product
• Rapid Prototyping

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

Carriers
• Carrier customization
• Certifications
• IOT and field debugging
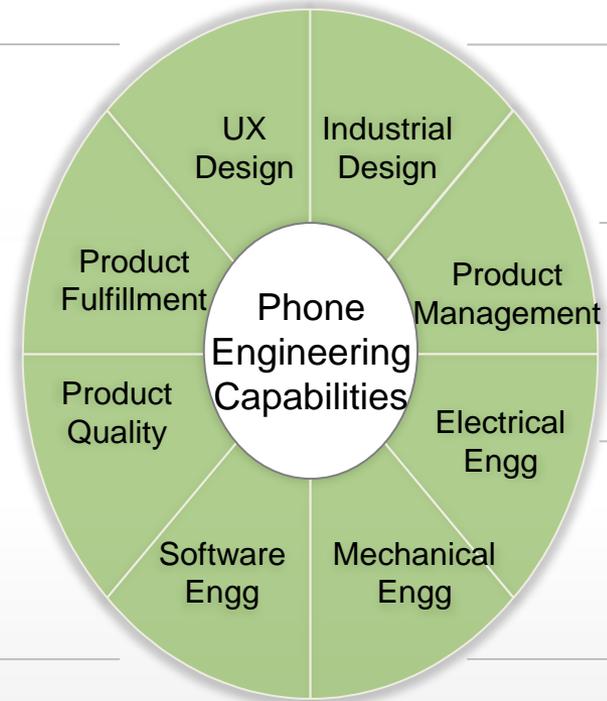
Software implementation
• Complete Software stack expertise: Base port till Application
• Platforms: Android (Linux), BREW

Manufacturing
• SCM, Manufacturing support
• FOB, FL, RL, CCO, Service mgmt

Product management
• Product definition
• Product P&L
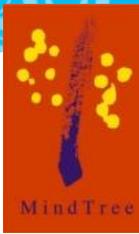• Requirement Management
• Technology Management

Phone Engineering Capabilities
- UX Design
- Industrial Design
- Product Management
- Electrical Engg
- Mechanical Engg
- Software Engg
- Product Quality
- Product Fulfillment

100+ PHONE MODELS

50+ CARRIER CERTIFICATIONS

45+ MILLION PHONES IN THE MARKET

Geography: NA, Canada, India and LATAM

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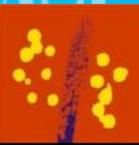
Client	Areas Of Work	Version Upgrade	Peripherals Integration	Application Development	UI Development	Frameworks/ Platform
Korean Phone vendor	Version Upgrades, Port changes, Application Development	🟢		🟢		
European Navigation device vendor	Test Framework Development, Platform Development		🟢	🟢		🟢
European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

Commercial Grade Products Developed

ANDROID

Developing custom applications Carrier customization

Enhancement/ Customization of framework layer

Customization/Integration libraries

Integration with target hardware

Carrier customization

Testing and test automation

Android Services Offering : Brief Summary

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 | Implementation | Deployment |

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

Device Testing

UI, Applications,
Camera, contents, Games,
Downloads, BT, Wi-Fi
Android, BMP

GSM, 3G,Protocols,
Pre GCF-PTCRB,
DG11

CDMA Protocols,
CDG 1, 2, 3

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

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

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CASE STUDIES

MindTree Smartphone (Neo) – 2009-10
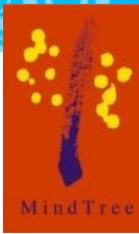
INDUSTRIAL DESIGN

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

Device Management:

- OMA-DM and FOTA capable

Memory

- 256 MB RAM and 512 MB ROM
- microSD upto 32 GB

Battery

- 1300 mAh Lithium-Ion

Audio:

- Dual Microphone noise suppression
- HAC & TTY Compliance
- 3.5 mm HSJ, Speaker phone
- 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)

- **Android Browser**
- **Google Mobile Services**

USP:

- OMNI, Quiver, Rainbow, Meadow

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

- Design, Development, Testing and performance optimization of Bluetooth applications and solutions for **multiple** customer specific platforms.
- Integration of Bluetooth with the platform and OS power management framework
- Develop/Optimize UART transport drivers for Bluetooth
- Implementation of Shared Transport Driver

Platform & Technology

- Android 2.1, 2.2, 2.3 and 3.0
- BlueZ for different versions
- PTS Test suite

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

GPS Host Solution on Android

Development and maintenance of GPS Stack for US Based semiconductor vendor
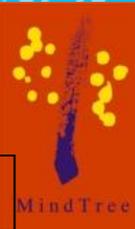
Objectives

- 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)

Tools and Technology

- Android 2.1, 2.2, 2.3, 3.0
- 3rd party SUPL servers and ULTS

Solution

- 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.

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

Tools and Technology

- Android 2.1, 2.2, 2.3 and 3.0
- Android CTS

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.

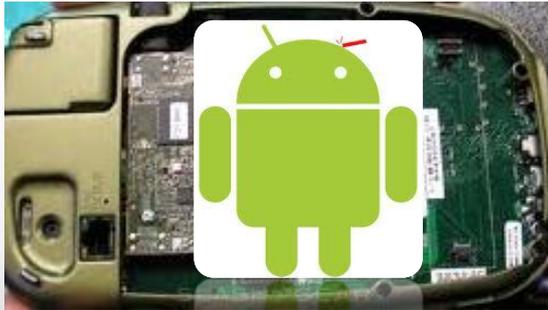# ZigBee Application and Profiles on Android

Application

JNI Layer

HA   SE
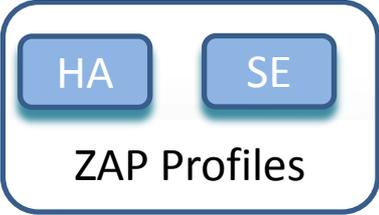
ZAP Profiles

Develop   Integrate

•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)
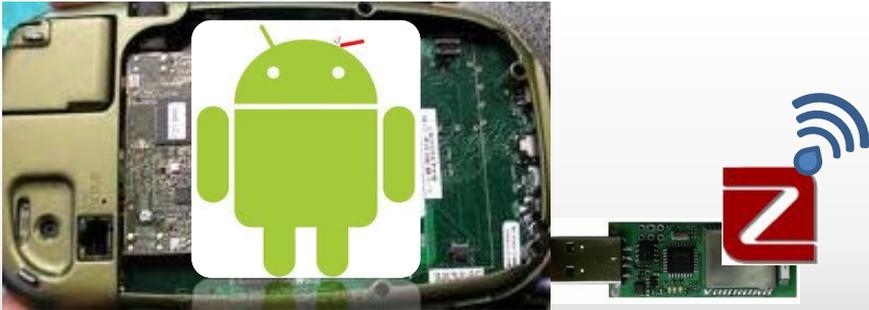
CC2531

Home Automation Eval board

Energy meter Eval board

RF4CE on Android

Application

JNI Layer

RF4CE Stack and Profiles

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

Media Controls

CC2531

OMAP 4 based TI platform (Blaze)

Video Conferencing Solution

MindTree internal initiative to provide solution accelerator for video conferencing

Objectives

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

Platform & Technology

- Android SDK for 2.1 and 2.2
- NDK 1.5
- Android compatibility test suite
- 3rd Party tools

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

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Mobile DLNA Solution (M-DMS and M-DMC)

DLNA Porting and application development for US Based Semiconductor vendor

Objectives

- Porting of DLNA stack from Linux
- Development of controller and configuration applications.
- Enhancement of DLNA Server and controller profiles for DLNA 1.5 compliance
- DLNA stack qualification for M-DMS and M-DMC

Platform & Technology

- Android 2.1 and 2.2 (NDK 1.5)
- DLNA 1.5
- CTT 1.5.00.56

Solution

- Development of JNI layers to integrate the DLNA stack (Implemented in C).
- Ported associated UPNP stack. Resolved multiple issues related to threading, synchronization and Bionic libc compliance.
- Interoperability testing. (Participation in plugfests)
- Tested with Conformance test tool (CTT Version 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

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.

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Problem Statement

- Interface with Sunny Portal RESTful webservices 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

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..
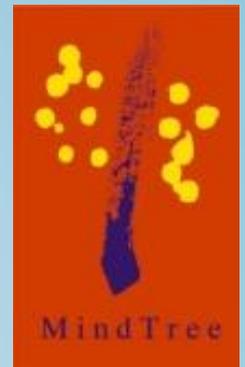
Our Mission

Successful Customers

Happy People

Innovative Solutions

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