



Smart-sleeve for iPhone enabling Dual SIM functionality

Introduction

Dual SIM phones have become extremely popular in the recent times, especially in countries where these phones are sold unlocked. The feature enables users to have two phone connections of same/different service providers, providing them access to better services while he's on move or manage personal/ professional communication via a single device.

Unlike Android phones, iPhones do not offer a dual SIM feature. Though iPhone XS and later versions come with a Nano SIM and eSIM option, these are not at par with an Android dual SIM phone. A user cannot use SIM of two different carriers, both plans must be from the same carrier, otherwise the iPhone must be unlocked. Some iPhone users may also prefer to have separate services to address their work and personal requirements, and hence may end up carrying two phones. In addition, iPhone user travelling outside his home network may have to carry a second phone to manage roaming calls and data, to avoid high charges. The Smart-sleeve is a powered iPhone accessory that addresses this concern.

This case study outlines Mistral's design and development expertise in building a smart iPhone accessory that offers Dual SIM functionality to iPhones, provides hotspot connectivity while also acting as a power bank for the host iPhone.

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The Customer

The customer is a start-up that provides innovative, user-friendly iPhone accessories.

The Requirement

The customer approached Mistral to develop an iPhone accessory that acts as a secondary SIM card device to enable Dual SIM functionality. The device once paired with an iPhone, had to facilitate both SIM cards to make / receive calls and send/receive SMS seamlessly, in addition to other functional requirements.

The Customer was very keen on minimising the product cost. The requirement was to keep power consumption at the minimal while providing long battery life. The customer was also very particular about product safety, minimising developmental risks, and faster time to market. The application interface was expected to be highly intuitive and user-friendly to enable a smooth and seamless switching between the SIM cards and using the phone features.

Solution Provided

The initial design of the secondary SIM card accessory provided by Mistral consisted of a dedicated microphone and speaker. However, since the cost of product had to be kept at the lowest possible range, Mistral redesigned the accessory and optimized Bill of Materials, removing microphone and speaker in the new design and enabling it to use the host iPhone's mic and speaker.

Mistral took an innovative approach towards developing the Secondary SIM accessory. After various design deliberations, the product was designed to resemble a sleek phone sleeve, wherein the iPhone could be glided down from the top to make a physical connectivity with the sleeve's lightning connector. This ensured that the smart sleeve also worked as a power bank for the iPhone.



At the same time, all other functionalities of the smart-sleeve were enabled through a logical connectivity with the iPhone. The smart-sleeve was designed to access iPhone's microphone, earpiece, speaker, etc. through a custom designed iOS application, leveraging BLE technology. The smart-sleeve runs an embedded application that interacts with the iOS application on the iPhone via BLE. Implementing BLE ensured low energy communication, facilitating longer battery life for both, the smart-sleeve and the iPhone.

This iOS application provides a secondary dialler, which facilitates all standard keypad functionalities including make/receive calls, send/receive SMS, etc. The iOS Application syncs with the phone's primary address book and provides access to view and manage contacts. The iOS application along with smart-sleeve application converts the iPhone to a dual SIM smart phone.

The smart-sleeve is also designed to work as a 3G/LTE hotspot. Basically, the device acts as Wireless Hotspot for iPhone or any other device the user connects to it. While the user is on move, he can keep all Apps on his device including social media apps like WhatsApp, Facebook, Twitter, etc in sync.



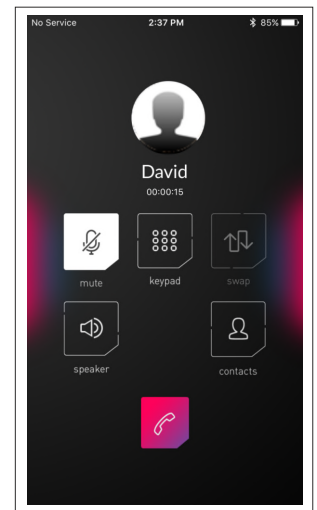
Built around AM335x processor from Texas Instruments, the smart-sleeve is designed with compelling hardware and software features such as flash storage for booting & configuration, Sierra 2G/3G module for Voice & Data connectivity, USB charging for both iPhone & sleeve, etc. Though the device was realised by implementing BLE technology, the sleeve was designed as per MFI guidelines. An MFI security chip integrated into the smart-sleeve makes it futuristic, ensuring an easy switch to Bluetooth over BLE for audio communications [using iAP2, iPod Accessory Protocol communication framework]. This enables the customer to upgrade the product without any hardware modification, while assuring secure communication with iPhone.

Technical Highlights

- ▶ Headless phone accessory for iPhone
- ▶ Dual SIM functionality
- ▶ Audio over BLE
- ▶ WiFi Hotspot
- ▶ Micro USB charging
- ▶ Embedded Linux
- ▶ 1700 mAH battery cum power bank
- ▶ FCC & CE compliant design
- ▶ iOS Application for functional pairing

Some of the features of the iOS Application when the smart-sleeve is paired with the iPhone include:

- ▶ The secondary Keypad has all standard features of an iPhone dialler
 - Make/receive calls from dialler screen
 - Display the status of calls when recipient ends the call
 - Copy, paste, edit feature from keypad screen
 - Muting and un-muting the microphone during a call
 - Holding and un-holding a call
 - Enabling loudspeaker
- ▶ Manage call waiting functionalities
- ▶ Receive call on iPhone SIM while a call is in progress on Smart-sleeve SIM
- ▶ Send/receive SMS and notifications
- ▶ Search, view and manage contacts
- ▶ Displays history of outgoing / incoming calls
- ▶ Displays SIM card status.



The iOS Application, which acts as a dashboard allows the user to enable Bluetooth, enable dialler tone, access sound settings, enable/disable data and Wi-Fi Hotspot from dashboard screen. The iOS App dashboard also allows the user to switch off the smart sleeve.

In addition, the sleeve works as a Power Bank (power source for iPhone to charge) and the same can be enabled or disabled from Dashboard screen.

Hardware Design

The device hardware is based on around AM335x processor from Texas Instruments, a 1GHz ARM Cortex-A8 processor with DDR3 & eMMC memory. Sierra wireless-based GSM radio module supports 2G / 3G communication and has the option to upgrade the product to 4G technology. The 2.4GHz WiFi module integrated in the design provides the hotspot facility to the primary iPhone device, leveraging the secondary SIM connection. A dedicated microcontroller is provided for configuration and control of various power modes and functionality. Mistral used energy efficient components and implemented effective power management techniques to ensure power optimization and battery management.

Mistral optimized the plastic ID design and provided prototypes along with

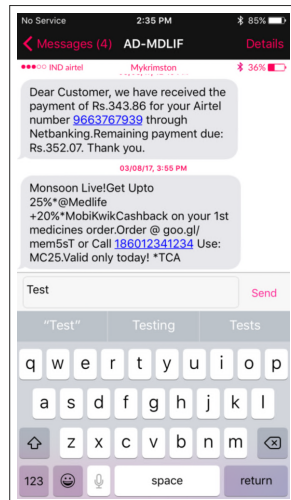
required production build data to the manufacturing house.

Software Design

The software development activities include:

Implementing an efficient power management mechanism for the sleeve

- Implementation of smart hot spot feature to conserve power and also efficiently get notifications from networking apps like WhatsApp, email, etc.
- Designing efficient BLE communication service for interactive voice communication
- iOS application based on SWIFT with an intuitive and responsive user interface
- Commercial Bluetooth stack integration on Linux platform
- SQLite database-based Address book on the Smart-sleeve.



the Sleeve.

BLE Communication

BLE is designed to exchange small amount of data periodically. One of the main challenges was to enable real-time two-way voice communication over BLE.

Mistral achieved this by:

- Using efficient audio compression and decompression
- Using efficient data queuing and de-queuing
- Using optimal size of data packets to minimize the communication overhead
- Using efficient BLE communication services and characteristics.

Key Achievements

- Secure and real-time BLE communication between the smart-sleeve and iPhone, which facilitated in optimization of the BOM by removing speaker and microphone from the sleeve and using the existing components on the iPhone
- A highly responsive, intuitive and user-friendly iOS application that enables users to access both Smart-sleeve and the iPhone diallers

Customer Benefits

- The product development, prototyping, testing and FCC/CE certifications have been completed in a very short duration, enabling the customer to get the product to market faster
- Reduced development cycle and time, as Mistral was a single stop solution provider from concept to deployment
- The MFi certified smart sleeve is designed in such a way that the customer can easily upgrade the product to make it compatible for upcoming iPhone models with minimum hardware modification.

The Challenges

Antenna design and placement

The initial design of the board had a Flex PCB antenna that was placed beneath the battery. However, this technique did not succeed as placing the Antenna beneath the battery had an impact on the Antenna efficiency.

After various design deliberations and exploring available options, Mistral decided to use a customized Antenna design. The antenna was designed using 'LDS Antenna Design Technology' and was integrated into the chin of



Mistral Solutions Pvt. Ltd.,
60, Adarsh Regent,
100 Feet Ring Road,
Domlur Extension, Bangalore - 560 071
Tel: +91-80-4562-1100
Fax: +91-80-2535-6444
E-mail: info@mistralsolutions.com

Mistral Solutions Inc.,
43092 Christy Street
Fremont, CA 94538
USA
Tel: +1-408-705-2240
E-mail: usa@mistralsolutions.com

Branch Offices:
INDIA
• Hyderabad
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