

- Preliminary -



(Pat. Pending)

Technical Overview

Dual Iridium, Thuraya SATCOM system

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Prelim		First Release	

Introduction

SafeCell provides an alternative approach for passengers to use their cell phones onboard aircraft without the requirement for installing complex GSM PicoCell network infrastructure. SafeCell directs the mobile phone services from communicating across its normal RF link to its Bluetooth link by using a proprietary Java application that is downloaded and installed on the passenger's cell phone.

The onboard installation of a Bluetooth access point, being similar to a WiFi installation, allows wireless connectivity from the passenger's mobile phone or any Bluetooth capable communications device such as laptops and PDA's.

The SATCOM transceiver provides dual satellite communications links for complete global coverage while offering a suite of voice and data connectivity services. The following diagram illustrates the operational infrastructure of the Dual SATCOM SafeCell system:

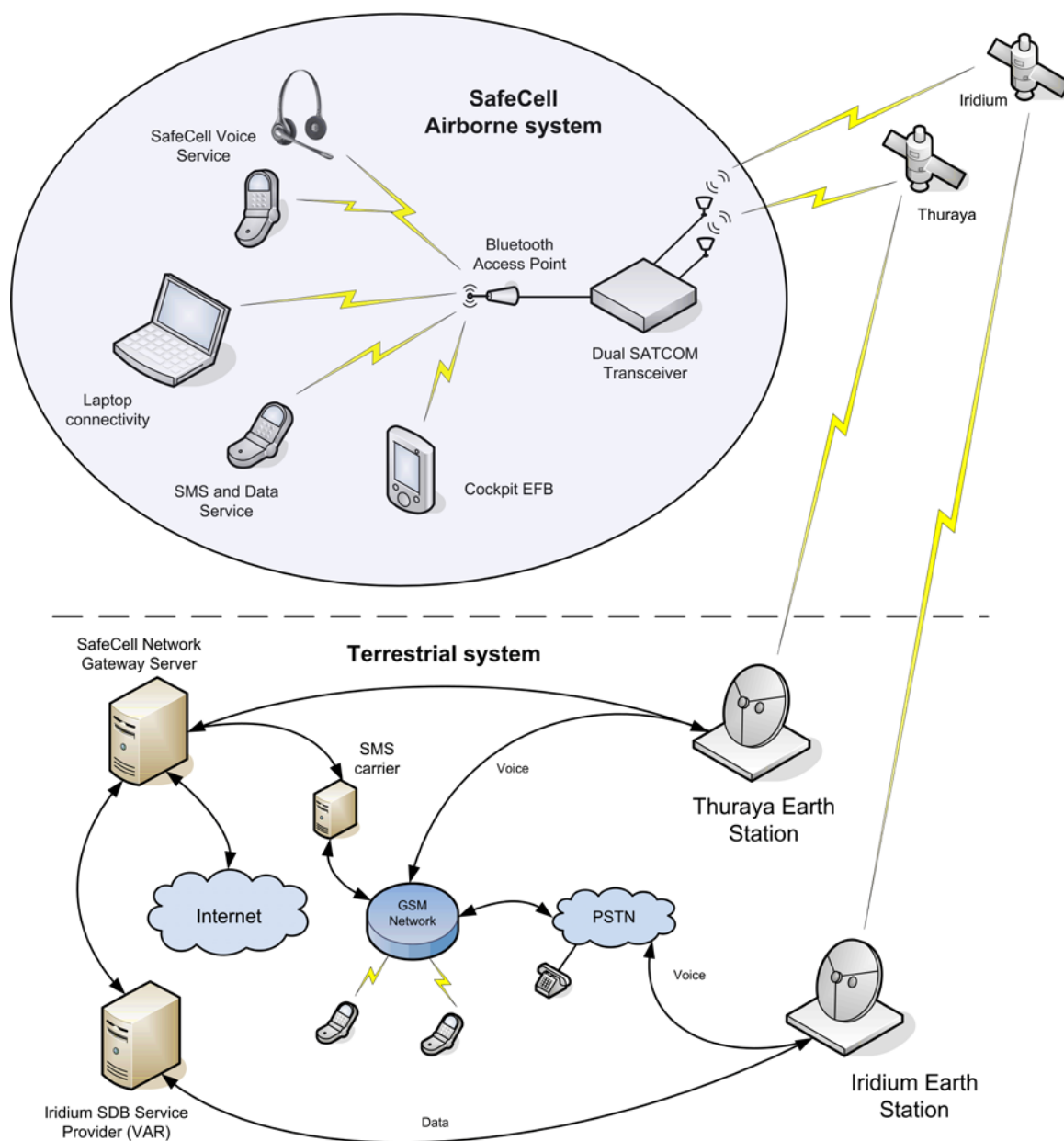


Figure 1. Top Level Schematic – Dual SATCOM SafeCell Architecture

Services

SafeCell Voice Service

The passenger combines the use of their existing mobile phone and a wireless Bluetooth noise reducing headset to place voice calls across both the Iridium and Thuraya networks. The headset is paired to the Bluetooth access point and maintains an independent wireless link to the voice channels provided by the SATCOM. The mobile phone has its own link and becomes the key pad control for placing calls. The features are;

- Ability to utilise all features of a mobile phone such as personnel address book to place calls
- Bluetooth headset specifically designed to cancel out the noise spectrum in the aircrafts cabin
- Wireless communications allows for freedom to move within the cabin of the aircraft.
- Ability to maintain a voice call while utilising the SMS and Data services available to the mobile phone. For example, you can be talking whilst receiving or composing an email or SMS.

Laptop connectivity

Laptops can also wirelessly connect to the SATCOM via the Bluetooth access point to access IP data services such as internet and corporate VPN.

SafeCell SMS and Data Service

Bidirectional SMS

An SMS message can be sent from the aircraft to a mobile phone by using an SMS carrier for the last mile delivery via a Telco network or by the Internet via the ASI network. Depending on the active SATCOM service at the time (Iridium or Thuraya), the SMS delivery can be handled by the senders Skype account or by the SafeCell gateway. A unique “reply only” number is generated by the SafeCell gateway as part of the message ID that is delivered to the receiver. This enables the receiver to identify the sender of a SafeCell generated SMS message (example; Jack when Flying). The receiver of the message can then reply as a normal SMS. The system also incorporates a “Follow me” technology; If the replied message happens to occur after the originator has landed and departed from the aircraft then the replied SMS message will be routed to the originators mobile phone number by the SafeCell gateway.

Bidirectional EMAIL

A text Email message can be generated by the SafeCell mobile application and delivered to the ground. The ground receiver can reply to the message by clicking the included http link at the bottom of the message body to activate a web form to generate the reply message. The SafeCell gateway manages the generated links to ensure that the passenger receives the email reply to their mobile phone when in the air or rerouted to their email address when on ground. The message size varies on the SATCOM system installed on the aircraft.

News Updates

SafeCell provides a dedicated PC application capable of delivering news bulletin updates to the aircraft.

Cockpit EFB

SafeCell can also provide a SATCOM communications link to existing EFB units for real time delivery of weather data and charts and NOTAMs. The EFB only requires an Ethernet connection and a software application that manages the connection. The EFB can also become a remote control panel for the SafeCell system by providing the pilot with system control and real time feedback. The EFB can also serve as a remote maintenance panel.

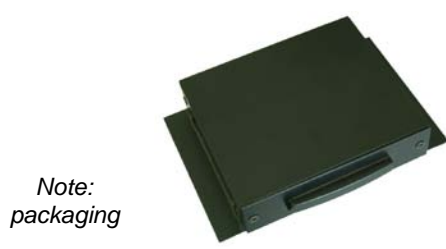
Airborne Segment – Installed LRU

The airborne segment of SafeCell system requires the following installed hardware components:

Qty	LRU
1	Bluetooth Access Point
1	SATCOM – Dual Transceiver
1	EFB – optional for cockpit data

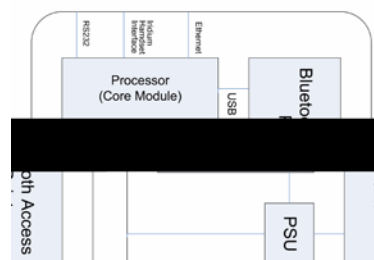
Bluetooth Access Point

The Bluetooth Access Points provide wireless connectivity between the passenger’s communication devices and the SATCOM within the aircraft environment. The Access point connects to the SATCOM via an Ethernet connection and is capable of supporting 21 simultaneous physical connections whilst maintaining 256 devices in a Park State. The Access Points are designed to comply with the functional requirements identified in Section 8 (Cabin Wireless LAN Unit) of the ARINC 763-3 Specification and under the operating guidelines stated in RTCA DO-294 and EUROCAE WG58 ED-118.



Note:
packaging

Prototype unit
options available



shown –

RF Characteristics	
Radio Characteristics	RF Input/Output: 2.4 GHz ISM frequency band 7 Operation Channels per Bluetooth radio 3 Radio devices per Access point
Receive Sensitivity	-85 dBm (Typical, for BER of 1<0.1%)
RF Output power	20 dbm
Operating Range	Up to 100 meters Class1. Lower power classes selectable (Class 3: 1mW max EIRP, 1m range)
Antenna	Integrated Chip Antenna

Network Characteristics	
Network Type	Compliant with Bluetooth specification V2.0 Message transfer via OBEX protocol
Data Modulation	Support for Adaptive Frequency Hopping (AFH) and 802.11 co-existence
Profiles	PAN,LAP,OPP,DUN
Protocols	TCP/IP, HTTP, FTP, DHCP, CHAP, PAP, Radius, SNMP, PPPoE
IP Assignment	DHCP, Radius or manual specified
Data Transfer	Enhanced Data Rate 2Mbps
Security	Radius, SNMP

Processor (Core Module) – control board		
CPU	1.8 GHz Intel Pentium	
Main Memory	1 GB RAM	
Mass Storage	32 GB Internal solid-state mass storage drive	
Peripheral I/O	Four (4) USB 2.0 ports Two (2) RS-232 serial port Two (2) 10/100 BaseT Ethernet port One (1) Compact Flash	
Operating Platform	MS-Windows Embedded XP O/S	
Handset Interface	PIN	DESCRIPTION
	HS GND	Handset Ground
	9 VDC HS	Handset Power
	HS TRU	3- wire buss
	HS CMP	3- wire buss
	HS RTN	3- wire buss
	HS TX	Handset Transmit
	HS RX	Handset Receive
Data Interface	PIN	DESCRIPTION
	RS232 RTS	RS232 RTS
	RS232 CTS	RS232 CTS
	RS232 RX	RS232 Receive
	RS232 TX	RS232 Transmit
	GND	Ground

Physical Characteristics	
Dimensions	135 x 130 x 25mm
Weight	178 grams

Electrical Characteristics	
Input Voltage	28VDC / 115VAC 400Hz
Input Power	0.18 Amps max (5 Watts max - normal operation)
Regulatory Compliance	Designed to meet DO-160D

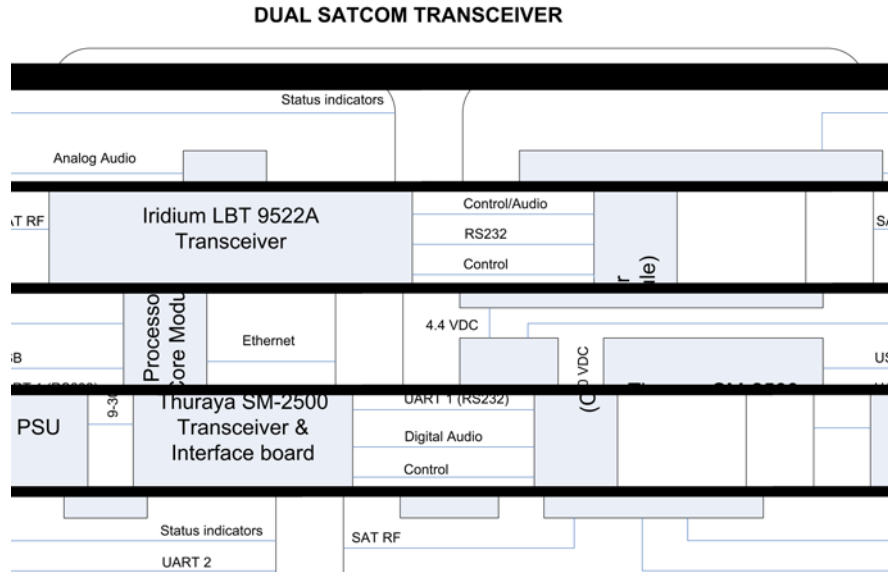
Iridium Handset Interface port

This interface connects to the Handset port of an existing Iridium SATCOM installation to provide access to the Iridium voice channel(s). The control module also provides a simplified implementation of a PBX that includes intercommunications and conferencing between the Bluetooth connected devices. The user communicates via a Bluetooth headset and user access and control is provided by their mobile phone which is also wirelessly connected to the system via the Bluetooth access point.

RS232 Data Interface

This interface connects to the RS232 port of an existing Iridium SATCOM installation to provide access to the Data services and system control using modem functionality via AT command control. The Iridium SBD service is used for the SafeCell SMS and Email messaging service.

SATCOM – Dual Transceiver



Thuraya module



a. Available SafeCell Services

- o SafeCell voice services (one channel)
- o Bidirectional SMS and Email to a Mobile Phone numbers and ASI users (Skype™ name)
- o Up to 4 simultaneous users accessing SMS and Data services
- o Instant messaging (Chat)
- o Bidirectional Media rich content (Video, Picture, Music, etc) to ASI users (Skype™ name)
- o Laptop Internet connectivity services

b. Transceiver

- o The Thuraya Transceiver is a small, light weight core transceiver module designed to communicate both voice and data over the Thuraya network.

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SafeCell – Technical Overview

Specification	
Radio Characteristics (Input impedance: 50 ohms)	RF Input/Output: 1525 – 1660.5 MHz
Interface Connectors	DC Power RS232 Data x 2 USB Interface Ethernet Control Digital Audio SIM Interface Antenna Connector (50Ω, TNC type)
Environmental Characteristics	
Operating Temperature	TBD
Physical Characteristics	
Size	35(H) x 110(L) x 130(W)mm
Weight	TBD
Cooling	Convection cooling only
Electrical Characteristics	
Input Voltage	9 - 30 VDC nominal / 3A current
Input Power	5 W (Max active), 2.52 W (Max standby)

c. **Thuraya Antenna**

- o The Thuraya fixed airborne antenna is designed specifically for aeronautical applications. It provides both the Thuraya LHCP and GPS RHCP antennas in one package.



Physical Characteristics	
Description	Active blade antenna
Size	Height: 4.55 in Length: 13.05 in Width: 3.78 in
Weight	2.5 lbs
Material	6061-T6 aluminium / thermoset plastic
Drag	1.1 lbs. Mach .85 @ 35,000 ft.

Environmental Characteristics	
Temperature	-65 to +185 DegF
Vibration	10 G's
Altitude	70,000 ft

SAT RF Parameters	
RX frequency band	1525.0 to 1559.0 MHz
TX frequency band	1626.5 to 1660.5 MHz
Polarization	LHCP
Beamwidth	160Deg x 160 deg
G/T Limit	-24dB/K
Min. non-backed off RF PA Output	2W
Power Control step size	0.4 db
RSSI range	-125 to 105 dbm
Impedance	50 ohms
Receiver Noise Figure	< 1.8dB

GPS RF Parameters	
Frequency	1575.42 +/- 1.023 MHz
Polarization	RHCP
Gain (at zenith)	-3 dBic
Axial Ratio	6.0dB
Output VSWR	1.5 dB
Output return loss	-10 dB

Federal and Military Certification	
Design To:	DO-160C, MIL-HDBK-5400, MIL-STD-810D

Iridium module



a. Available SafeCell Services

- SafeCell voice services (one channel)
- Bidirectional SMS and Email to a Mobile Phone numbers and ASI users (Skype™ name)
- Up to 4 simultaneous users accessing SMS and Data services

b. Transceiver

- The 9522A L-Band Transceiver (LBT) is the core transceiver module required to communicate both voice and data over the Iridium network. The LRU incorporates the additional Power supply, environmental protection and the serial based interface to the SafeCell Control panel.

Characteristics	
Radio Characteristics (Input impedance: 50 ohms)	RF Input/Output: 1616.0 – 1626.5 MHz (L-band) Average power during Tx slot (max): 7W Average power during a frame (typical): 0.6W Receiver sensitivity at 50Ω (typical): -118.5 dBm
Interface Connectors	25 pin D-subminiature Multi-Interface Connector DC Power RS232 Data Control Audio Antenna Connector (50Ω, TNC type) SIM Chip Connector
Environmental Characteristics	
Operating Temperature	-20°C to +60°C at ≤ 85% RH
Physical Characteristics	
Size	39(H) x 196(L) x 83(W)mm
Weight	610g
Cooling	Convection cooling only
Electrical Characteristics	
Input Voltage / Current	External +4.0 to 4.8 VDC (4.4 VDC nominal) 2.5 A @ 4.4 VDC
Input Power	2.5 W (avg active), 210mW (avg standby)

c. **Iridium Patch Antenna**

- o The Iridium fixed airborne antenna is designed specifically for aeronautical applications. The bolt mount antenna provides for quality communications at high speed and altitudes. The antenna is robust in design and allows for a flat fixed mount to an aircraft using adhesive gasket and mounting nut.



Physical Characteristics	
Description	Patch antenna - hemispherical radome
Size	Diameter: 66.04 mm Height: 14.81 mm
Weight	113 g

Electrical Characteristics	
Impedance	50 ohms
Polarization	RHCP
Gain	+4.4db
VSWR	< 1.5:1
Connector	TNC Female

Environmental Specifications	
Temperature	-55 to +85°C
Altitude	70,000 ft
Vibration	> 30 G's

RF Characteristics	
Frequency	1610.0 – 1626.5 MHz

Federal and Military Certification	
Design To:	FAA TSO-C144, DO-160D, DO-228, MIL-C-5541, MIL-E-5400, MIL-I-45208A, MIL-STD-810, SAEJ1455

Certification

Aviation Approval:

The design and installation of the SafeCell System including the cabin Bluetooth Wireless Network will comply with the guidelines of **RTCA D0-294B** and the airworthiness aspects of;

1. EASA's STC certification process including the relative requirements contained in annex I of CE reg. 1592/2002.

Or..

2. FAA's STC certification process including the relative requirements contained in AC 91.21-1A

The **RTCA D0-294B** also details the regulatory guidelines for authorities, aircraft operators and aircraft manufacturers to determine acceptable and enforceable policies for passenger and crew use of portable electronic devices.

Specific references to Bluetooth:

RTCA D0-294B

3.B Transmitting Portable Electronic Devices: T-PED Characterization Matrix

This appendix contains the list of T-PEDs considered by RTCA SC-202 during their investigations which includes Bluetooth (3.B.1.3 Unlicensed Devices, Technology: 802.15.1 – Bluetooth)

3.D.3.2 RF Considerations

*Bluetooth-equipped devices occupy the same 2.4 GHz ISM frequency spectrum and utilize frequency hopping modulation schemes similar to some IEEE 802.11 WLAN devices; however, they operate at **lower levels** than WLAN devices*

WPAN (Bluetooth networks) and WLAN (WiFi networks) frequency hopping technologies are sufficiently similar that evaluation of WLAN devices worst-case will subsume WPAN

8.A.4.3.1 Non-Critical Phases of Flight

While all PEDs should be switched OFF and fully disconnected from any in-seat electrical power supply during critical phases of flight, the operator may consider that these restrictions associated with active transmitting devices does not need to apply to low power transmitting devices that are fully compliant to the Bluetooth standard

Safety Evaluation of Bluetooth Class ISM Band transmitters on board Commercial Aircraft – Rev 2 December 2000 (Intel document)

In December 2000, Intel released a report "Safety Evaluation of Bluetooth Class ISM Band Transmitters on board Commercial Aircraft", which recommended that FAA and JAA regulations be modified to specifically allow Bluetooth devices to be used during flight. In October 2001, the JAA issued Leaflet No. 29 "Guidance Concerning the Use of Portable Electronic Devices on board Aircraft", which specifically permits Bluetooth transmitters to be operated during non-critical phases of flight.

Certification Process:

- 1 The STC certification plan for SafeCell systems and Bluetooth Wireless Networks covers the following topics:
 - a. Certification Plan
 - b. Safety Objectives
 - c. Acceptable means of compliance
 - d. Aircraft Flight Manual
 - e. Instruction for continued airworthiness

- 2 System design, installation and operation comply with the following:
 - a. System designed to meet the Guidance on the Approval of Intentionally Transmitting Portable Electronic Devices for Use on Aircraft as defined in RTCA D0-294B
 - b. SafeCell System components are manufactured to meet the environmental conditions and test procedures as defined in RTCA D0-160D.
 - c. Specifically related to the Bluetooth Wireless network components, the following RTCA D0-160D categories will apply;
 - Section 15, Magnetic Effect, Category A.
 - Section 21, Emission of Radio Frequency Energy, Category M.
 - Acceptance criteria
 - Minimum immunity level
 - EMI and RFI testing (Radio electromagnetic compatibility tests)

 - Other requirements
 - Worst case power conditions: Ref IEEE 802.15.1
 - Radio Frequency field strength: Ref IEEE 802.15.1
 - Transmission specifications (including spurious emissions)
 - T-PED operational constraints, quantities and population assessment

Flight testing:

The operator will be provided with a Wireless Project Issue Paper outlining the hardware involved in the flight test and supporting documentation addressing any safety concerns with;

1. Radiation exposure to airplane occupants
2. Interference with on-board avionics

Supporting industry specific documentation highlighting the relevance of using the same certification standards and documentation for Bluetooth wireless transmission as for Cabin Wireless LAN (WiFi) systems will also be provided. Refer below "*Certification References*"

Certification References:

General equipment installation

- RTCA DO-160D
- EASA / FAA STC certification process
- ARINC 763-3

Wireless network

- RTCA DO-294B / EUROCAE ED-118
Evaluation of the use of portable electronic devices (PEDs) onboard civil aircraft with emphasis on intentional transmitters (T-PEDs). Provides specific recommendations for testing aircraft immunity from passenger T-PEDs and onboard wireless networks. Details primary steps required to achieve certification and provide guidance to develop airline operational procedures.
- FAA AC 91.21-1B
Provides aircraft operators with information and guidance on the operation of PEDs for compliance with 14 CFR part 19, section 91.21. Intended to clarify use of “Intentional Transmitters” such as wireless LAN installed onboard aircraft. Based on RTCA SC-202 findings and D0-294 Phase 1 document
- JAA TGL-29
Provides aircraft operators with information and guidance on the operation of PEDs for compliance with JAR-OPS 1.110.
- CAA (UK) CAPS-756
Reference document for the effects of PED-generated electromagnetic fields, as they apply to large transport aircraft covered by EASA Regulation CS-25.

Industry related reports

- Safety Evaluation of Bluetooth Class ISM Band transmitters on board Commercial Aircraft – Rev 2 December 2000 (Intel document)
- NASA Langley Report on EMI in Aircraft 2005