



To Cabin Systems Subcommittee **Date** April 21, 2010

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Subject **Strawman Circulation**
Strawman for Project Paper 833: *Wireless Distribution*

Summary The attached strawman draft of Project Paper 833, submitted by Boeing, proposes a new ARINC standard for wireless communications in the cabin. The intent is to enable common wireless distribution of disparate wireless system signals.

The CSS will review the strawman and any comments received at their next meeting. The next meeting is tentatively scheduled for May 25-28, 2010, in Evreux, France. For details of this meeting refer to the CSS meeting Announcement posted on the ARINC Website at the following URL:

<http://www.arinc.com/aeec/announcements/>

Action Please review the strawman and notify Tom Munns in writing (e-mail) by **May 17, 2010**, if you have any comments.

Strawman for
ARINC Project Paper 833
Wireless Distribution

**ARINC SPECIFICATION 833
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1.0 INTRODUCTION

1.0 INTRODUCTION

1.1 Purpose and Scope

The ARINC 833 specification describes a system which provides wireless communication channels in the cabin. This system may reduce the installation and integration effort of multiple stand-alone wireless systems. In addition, the Arinc 833 specifies the interface between multiple wireless systems to the Universal Wireless Distribution System (UWDS). Compliance with the ARINC 833 specification enables common wireless distribution of disparate wireless system signals.

The system includes the following components:

- ➔ RF-Combiner unit(s))
- ➔ Cabin broadband antenna(e)

The ARINC 833 specification ~~itself only~~ addresses the interfaces to the UWDS, RF-Combiner Unit and the broadband antenna. The figure below provides an overview of ~~the the complete system, according to ARINC. Rr~~ Relationship to other **ARINC** Documents.

~~Figure 1-1 provides an overview of the complete system and its relationship to other ARINC specifications.~~

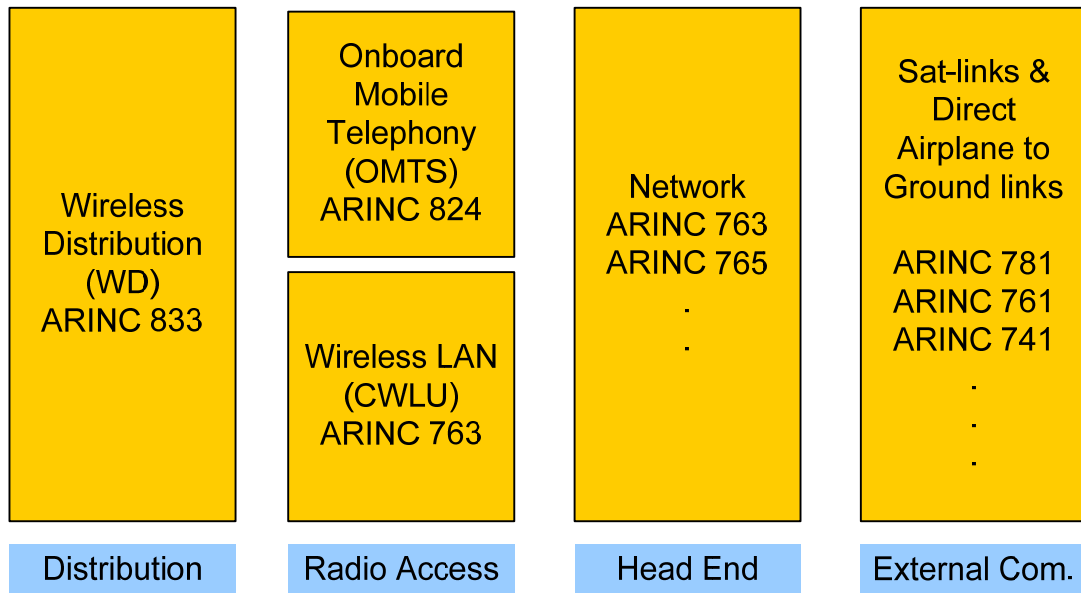


Figure 1-1 – ARINC 833 Relationship to other relevant ARINC Standards for the distribution of wireless access

1.0 INTRODUCTION

The UWDS standard includes the physical interfaces, connectors, space envelopes, equipment mounting, component co-location requirements, antenna characteristics, frequency range and power requirements. Design guidelines are included as far as they impact the interfaces and installation of cabin equipment on board the aircraft.

The system specified in this document may be designed to support wireless passenger and crew/flight deck applications in the A/C cabin, flight deck and cargo area. This specification describes a system that should be designed for maximum functionality and scalability.

1.0 INTRODUCTION

The latest versions of the following documents are referred to within this specification and may apply to the design, test, and certification of the OMTS:

ARINC Report 413A: *Guidance for Aircraft Electrical Power Utilization and Transient Protection*

ARINC Specification 600: *Air Transport Avionics Equipment Interfaces*

ARINC Report 607: *Design Guidance for Avionic Equipment for Category (A) utilization equipment*

ARINC Report 609: *Design Guidance for Aircraft Electrical Power Systems*

ARINC 628 Part 1: Cabin Management and Entertainment System – Peripherals

ARINC 628 Part 9: Cabin Information Network

ARINC 664 Part 2: Aircraft Data Network - Ethernet Physical and Datalink Layer Specification

ARINC 664 Part 3: Aircraft Data Network – Internet Based Protocols and Services

ARINC 664 Part 4: Aircraft Data Network – Internet Based Address Structures and Assigned Numbers

ARINC 741 Part 2-9: Aviation Satellite Communication System Part 2 System Design and Equipment Functional Description

ARINC 761-3: Second Generation Aviation Satellite Communication System, Aircraft Installation Provisions

ARINC 781-2: Mark 3 Aviation Satellite Communication System

Project Paper 791: Ku Band System

ARINC Characteristic 746: *Cabin Communications System (CCS)*

ARINC Characteristic 763: *Network Server System (NSS)*

ARINC Specification 809: *Seat Distribution System*

Project Paper 833: Cabin Wireless Distribution System

ARINC Specification 834: Aircraft Data Interface Function (ADIF)

RTCA DO-160E: Environmental Conditions and Test Procedures for Airborne Equipment

ETSI TS 102 576: *Technical Specification. Electromagnetic compatibility and Radio spectrum Matters (ERM); Digital cellular telecommunications system (Phase 2+); Radio access network equipment specification; GSM onboard aircraft; Technical and operational requirements of the GSM onboard aircraft System*

ETSI EN 302-480: *Candidate Harmonized European Standard (Telecommunications series). Electromagnetic compatibility and Radio spectrum Matters (ERM); Harmonized EN for the GSM onboard aircraft system covering essential requirements of Article 3.2 of the R&TTE Directive*

RTCA DO-294B: *Guidance on Allowing Transmitting Portable Electronic Devices (T-PEDs) on Aircraft*

RTCA DO-307: *Aircraft Design and Certification for Portable Electronic Device (PED) Tolerance*

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EUROCAE ED-118: *Report on Electro-magnetic Compatibility between Passenger Carried Portable Electronic Devices (PEDs) and Aircraft Systems*

EUROCAE ED-130: *Guidance for the Use of Portable Electronics Devices (PEDs) On Board Aircraft Preparing an Initial Document*

CEA CEB 18: *Recommended Practice for Transmitter Control and Status Indication in Transmitting Portable Electronic Devices (T-PEDs)*

ECC Decision ECC/DEC/(06) 07: *ECC Decision of 1 December 2006 on the harmonized use of airborne GSM systems in the frequency bands 1710-1785 and 1805-1880 MHz*

3GPP TS 45.005: *requirements for the transceiver of the pan-European digital cellular telecommunications systems GSM*

3GPP TS 25.104: *Base Station minimum RF characteristics of the FDD mode of UTRA.*

IEEE Std 802.11a-1999(R2003): *Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications High-speed Physical Layer in the 5 GHz Band*

IEEE Std 802.11b-1999 (R2003): *Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications: Higher-Speed Physical Layer Extension in the 2.4 GHz Band*

IEEE Std 802.11g™-2003: *Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications Amendment 4: Further Higher Data Rate Extension in the 2.4 GHz Band*

4.2 Interoperability

System interoperability as defined in Section 2 of **ARINC Report 607:** *Design Guidance for Avionics Equipment* is desired for the BTS, NCU, Combiner, and INCU. This document provides standards for the form and fit of the line replaceable modules, and defines the basic functions that the system will perform. Detailed functionality, protocols, and design parameters are unique to each system supplier and will not be covered within this document. This is intentional to allow users and manufacturers to tailor the system to an airline's specific needs while allowing for standardized provisioning of space and connections regardless of equipment provider. All OMTS implementations described in this document should be interoperable within an aircraft category, e.g., wide body/dual aisle or narrow body/single aisle at the component level. All OMTS implementations described in this document however should be interoperable at a basic functional level for all aircraft types (narrow and wide body).

4.31.2 [Ma1] Regulatory Approval

The equipment should meet all applicable aviation and telecommunication regulatory requirements. It is out of scope for this document to set forth the specific requirements that the equipment must meet in order to be assured of approval. This information must be obtained from the appropriate regulatory authorities.

4.41.3 Reliability

Overall reliability of the **OMTSUWDS** is not a requirement that is specified in this characteristic, but equipment designers should consult particular airframe manufacturers and/or end customers to gauge/meet expectations (contractual requirements) and heed the importance of the availability of the **OMTSUWDS** once

1.0 INTRODUCTION

installed. Each individual customer is expected to have high expectations on MTBF and MTBUR.

COMMENTARY

The anticipated operational use of the system demands the utmost attention to the need for reliability in all phases of system design, production, installation, and operation of the **OMTSUWDS**. A special emphasis should be given to total system quality, including built in testing, ramp testing, and shop testing to increase the Mean Time Between Unscheduled Removals (MTBUR). MTBUR has a profound affect on airline operations, despite a high MTBF. Airlines also have a high interest in reducing No Fault Found (NFF) rates with a goal of less than 20%. Airlines have a heightened interest in identifying and correcting the root cause(s) of unnecessary LRU removals, many of which result in a NFF disposition. Each NFF occurrence represents an unacceptable additional and excessive cost of ownership to the airline. All efforts in the developmental process to eliminate NFF occurrences will go toward improving the MTBUR. For airline operations, MTBUR is at least as important, perhaps more so, than MTBF.

4.51.4 Testability and Maintainability

The **equipment described in this standard should report sufficient information** ~~total system quality should include adequate ability for the operator~~ to test and maintain the **OMTS wireless distribution system** effectively. The **OMTSUWDS** designer should confer with the user to establish goals and guidelines for testability to minimize unnecessary removals. The use of advanced Built-In Test Equipment (BITE), ramp-testing equipment and adequate documentation will help the operators improve MTBUR. [A2] Testability should provide for the rapid identification of the root cause(s) of repeat removals and ultimate elimination of unconfirmed faults. ~~Testability should also provide support for optimized tests after installation or after exchange of OMTS LRUs.~~

The design of physical access and functional partitioning of the UWDS should be designed to minimize repair time. Where possible, excessive unit disassembly should be avoided for internal component replacement.

4.5.1 ~~On-Aircraft Maintainability~~

~~The flight and maintenance crew should have the ability to interact via the control panel, cockpit panel, integrated control panel or external laptop with the OMTS for system testability and maintainability.~~

~~The Server Unit (external to OMTS) should facilitate the centralized BITE, system monitoring. Data loading of the OMTS components should be implemented via Ethernet.~~

[Ma3]

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1.5.2 Shop Maintainability

The design of physical access and functional partitioning of the OMTS should be designed to minimize repair time. Where possible, excessive unit disassembly should be avoided for internal component replacement.

COMMENTARY

Full and complete documentation included in a Component Maintenance Manual (CMM) will also facilitate effective maintainability.

1.6^[Ma4]

1.0 INTRODUCTION

Certification and Software Security and Partitioning Considerations

The OMTS design when integrated into an aircraft system will follow both SAE ARP4765 “Certification considerations for Highly Complex Aircraft Systems” and SAE 4761 “Guideline Methods for conducting the Safety Assessment Processes on Civil Aircraft”. The certification authority may also require specific aspects to be addressed which should be addressed by the equipment manufacturer and system installer.

The results of the aircraft SSA^[A5] assigns particular OMTS functions with appropriate Design Assurance Level (DAL) and thus will define the system architecture.

The equipment manufacturer will then be required to follow RTCA DO-178 “Software considerations in Airborne Systems and Equipment Certification”, RTCA DO-254 “Design Assurance Guidance for Airborne Electronic Hardware” and RTCA DO-200A “Standards for Processing Aeronautical Data” at the appropriate assurance level derived from the aircraft SSA.

A security assessment, as defined in ARINC 811, should be conducted on the OMTS and attached systems to ensure that no adverse affects to avionics equipment or bearer systems results from the installation and use of the OMTS.^[Ma6]

4.0 CONFIGURATION

2.0 SYSTEM OVERVIEW

The OMTS is part of a multi-program cabin connectivity system, which extends the availability of common mobile/cellular telephony services into the aircraft. It can be based on a number of different technical standards (e.g., GSM1800, GSM1900, GPRS, EDGE, and CDMA). The general system architecture includes two segments (see Figure 2-1).

The UWDS can be the wireless distribution part of a cabin connectivity system. One possible system architecture is shown in Figure 2-1 – Example for System Segment Architecture.

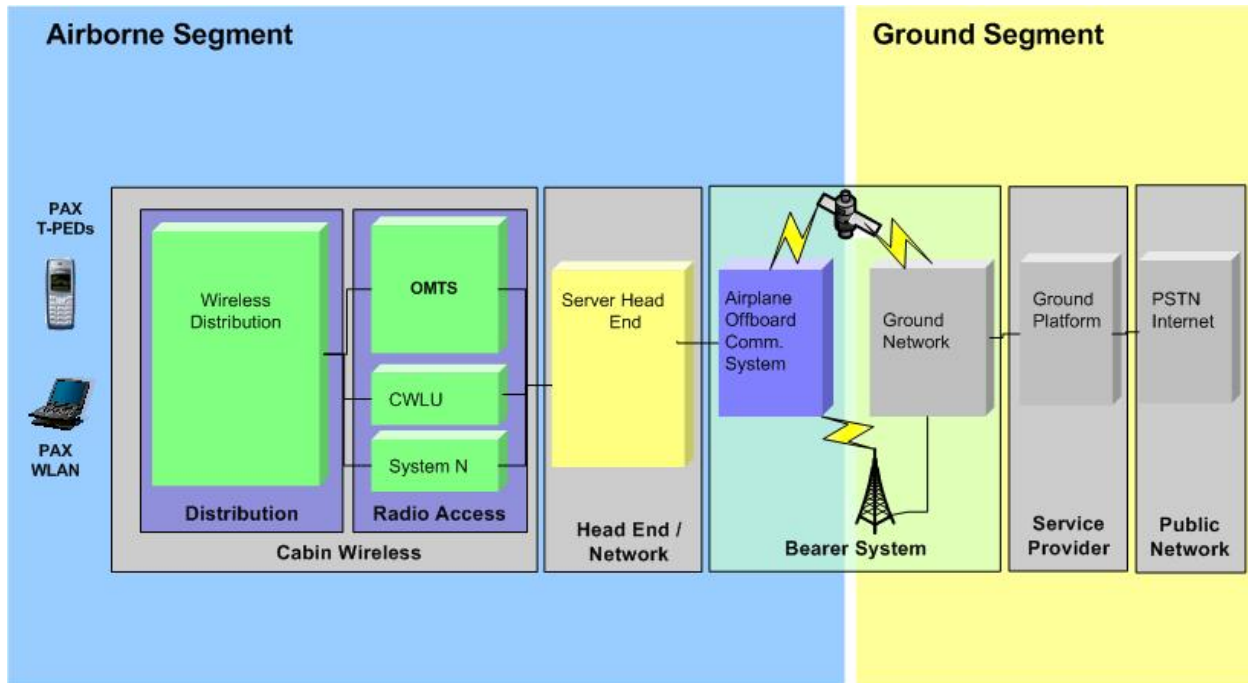


Figure 2-1 – Example for General System Segment Architecture

- The airborne segment comprises all functionalities on the aircraft needed to provide radio access to passengers T-PEDs¹ (Intentionally Transmitting Portable Electronic Device). It also includes all functionalities that are required to gain power control over all mobile devices onboard the aircraft.
- The ground segment interfaces to the bearer service providers systems (e.g., satellite or air-to-ground cellular networks) and transmits/receives the data stream from/to the off-board communication system inside the aircraft.

The bearer network link connects the airborne and ground segment, providing the transportation and interconnection to terrestrial service providers and backbone networks and the aircraft T-PEDs and laptops.

¹ Use of the term "T-PED" conforms to usage in RTCA, EUROCAE, and ICAO. It includes technologies such as existing devices enabled with cellular technologies and Wireless Local Area Networks (WLANS)

4.0 CONFIGURATION

~~The OMTS system offers communication services to T-PEDs that support commercial mobile radio services. Functional improvements of the OMTS system should be capable of being performed through the addition or enhancement of modules without modifications on the aircraft.~~

~~ARINC Specification 824 is designed for maximum functionality and is scalable to all relevant commercial aircraft types.~~

[Ma7]

2.1 General Description of Wireless Distribution Related Functions

The wireless distribution system provides the RF interface to wireless electronic devices for voice and data services.

The system is designed to operate with common wireless communication standards (e.g. GSM 900, GSM 1800, WLAN 802.11a/b/g, CDMA) and supports a frequency range from at least 400 MHz to 6 GHz.

The system, at minimum, should provide RF coverage everywhere in the A/C cabin. Additionally, coverage can be provided in the cargo bay, in the crew rest compartment and on the flight deck.

2.2 System Modularity

The architecture of the Universal Wireless Distribution System allows for a modular approach, depending on the number of systems to be connected to the UWDS. The system consists of two main components; one is the means for signal combining and splitting and the second is the means for the signal transmission and reception. The following sections describe the components in more detail.

2.2.1 Combining and Splitting Unit

The combining and splitting unit is the interface to the connected wireless systems. ~~The unit can (depending on the number of connected transmitters) either be a passive or an active device.~~ The active combiner/splitter requires a power supply and may use software for maintenance, controlling functionality and RF-power.

The RF combining and splitting unit supports a certain number of RF ports (separated into transmission and reception path) on the Arinc600 connector side in order to connect different RF systems. On antenna side, the RF combiner provides two ports for the reception- and the transmission antennae. The RF combiner is able to:

4.0 CONFIGURATION

- Combine a number of radio frequency signals on ARINC600 side and send the combined signals to its transmitting port on antenna side
- Split a combined signal and distribute it to the according reception ports on Arinc600 side.

2.2.2 Broadband Antenna

The main purpose of the broadband antenna is to distribute signals provided by several RF systems within the cabin (e.g. WLAN, GSM) instead of several conventional antennas for each RF system and frequency range. The broadband antenna is required since the UWDS supports different wireless standards. ~~(see appendix) [Ma9]~~. Because of the required homogenous signal distribution and the broad frequency range the use of a radiating coax as antenna is likely. Therefore this standard defines characteristics assuming a radiating coax antenna is used.

The broadband antenna should meet **the following minimum** characteristics to ensure ~~connectivity functionality~~ **with** the combiner:

Type of Connector:	N-Type Male [Ma9] or TNC Male
Impedance:	50 Ω
Minimum Antenna Gain:	See Appendix 2/Section 4 [Ma10]
Termination Resistor:	Sufficient to dissipate the power at antenna output, typically 2W. 2W
Frequency Range:	400 MHz to 6000 MHz

Choice of a broadband antenna and combiner depends on many other factors like:

- Link budget of the supported standard
- Cabin RF environment
- Frequency |

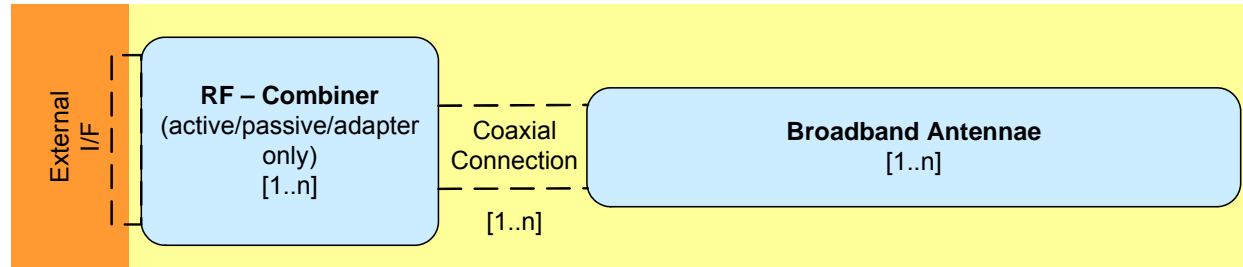
[Ma11]

3.0 SYSTEM UNITS AND INTERFACES

4.0 CONFIGURATION

3.1 General Description of the System Units

[Ma12] The wireless distribution system consists of at least one broadband antenna and a RF combiner (active or passive). A schematic architecture of an extended architecture solution including a broadband antenna system and one RF-Combiner is given in the figure below.



3.1.1 RF Combiner

The combining and splitting unit provides the Interface to the Broadband cabin antenna and to the systems connected to the UWDS. For the broadband distribution antenna part the combining and splitting unit provides at least two RF ports.

In addition the combining and splitting unit provides interfaces to the connected wireless systems as well as for the optional power supply and data connections.

All **system** interfaces to the **UWDScombiner should beare** centralized at the Arinc connector. This connector **should** includes the RF-interfaces to the attached systems, the Ethernet Pins, all discrete inputs and the power supply.

The Broadband antenna N-type connectors should be located at the front side of the combiner

Functional and operational requirements

Channel activation / inhibition:

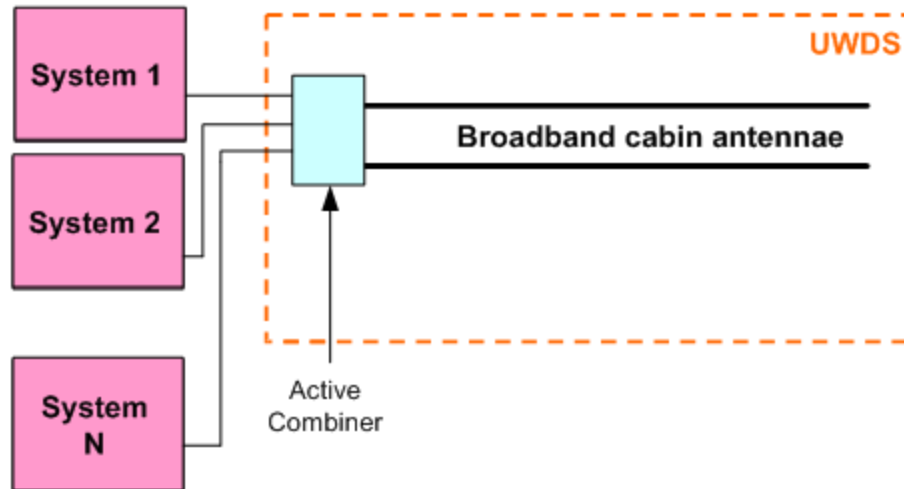
In normal operation, channels of the RF Combiner can be powered-off when the corresponding CWLUs are OFF. Channels can be powered-on when corresponding CWLUs are operating. Channels are powered-off again when no burst have been detected.

4.0 CONFIGURATION

3.1.2 Broadband Antenna

The RF interface^[Ma13] of the broadband antenna **should be** a standard N or TNC male connector.^[SHR14]

~~To be a standard should be one or the other (e.g. TNC or N type) otherwise the connecting cable will need to alter?~~^[SHR16]^[Ma17]



4.0 CONFIGURATION

4.1 Supported Standards/Interchangeability Objectives

The UWDS should be able to support any number of communication protocols operating in the 400MHz to 6GHz frequency spectrum. However, when implementing the UWDS, the designer should consult the applicable communication standards to ensure adequate RF link budgets are maintained for the desired application. Some examples of relevant communication standards are:

- GSM 3GPP TS 45.005
- UMTS 3GPP TS 25.104
- WLAN IEEE Std 802.11a
 IEEE Std 802.11b
 IEEE Std 802.11g

~~This section sets forth the specific form factors, mounting provisions, interconnect wiring, input and output interfaces, and power supply characteristics desired for the OMTS equipment. These standards should permit the parallel, but independent design of compatible equipment and airframe installations. Attachment 1 specifies an interconnection scheme by which aircraft can be wired to enable interchangeability between OMTS products from different suppliers.~~

4.0 CONFIGURATION

Attachment 1 also specifies a minimum interface configuration which can be viewed as a desirable future implementation on new aircraft because of its potential for significant weight and space savings along with the possibility for less complex integration into the OEM production environment.

COMMENTARY

Manufacturers should note that although this specification does not preclude the use of standards different from those set forth herein, the practical problems of redesigning a standard airframe installation to accommodate special equipment could very well make the use of that equipment prohibitively expensive for the customer. They should recognize, therefore, the practical advantages of developing equipment in accordance with the standards set forth in this document.

4.2^[Ma18] Configuration Options

[DELETED] – Suggest an equivalent to be provided for UWDS^[Ma19]

4.34.2 Link Budget Considerations

[DELETED] – Suggest an equivalent to be provided for UWDS

4.44.3^[Ma20] Electrical Characteristics

4.4.14.3.1 RF Input/Output Characteristics

To interface with Leaky line Antennas, CWLU's and OMTS (NCU or INCU).
The following tables show performance for each interface point.

TX path	
Signal	Max VSWR
OMTS input	2^[JRL21]
CWLUs 802.11 b/g input	2

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CWLUs 802.11 a input	3
TX Leaky Line output	1,7[Ma22]

RX Path	
Signal	Max VSWR
OMTS output	2
CWLUs 802.11 b/g output	2
CWLUs 802.11 a output	3
RX Leaky Line input	1,7[Ma23]

4.4.2 Levels Input/Output Characteristics [Ma24][Ma25]

The following performance give the necessary boundary condition for the system. To achieve those performance the relevant IEEE specifications must be verified, specially against the amplified WLAN signals; the linearity and corresponding spectrum must be compliant according to those standards. [JRL26]

The following tables describe the expected RF input and output characteristics in both directions of the RF combiner. The relevant communication standards apply (see chapter 4.1 [Ma27])

WLAN systems	RF level at RF Combiner inputs	RF level Range at TX antenna port	RF Max Level
IEEE 802.11 b/g	15 to 20 dBm [Ma28]	20dBm ± 1,5 dB	30dBm

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IEEE 802.11 a/h	15 to 18 dBm [Ma29]	20 dBm \pm 1,5 dB	30dBm
OMTS	16 to 33dBm		12W RMS

WLAN systems	RF level at RX antenna (Receive side)		Max RF level at WLAN Modem (Receive side)
	Min	Max	Max
IEEE 802.11 b/g	- 82 dBm	- 35 dBm	-20 dBm [SHR30]
IEEE 802.11 a/h	- 82 dBm	- 45 dBm	-30 dBm [JRL31]

4.4.3 Levels Input/Output Characteristics (Passive Combiner) [Ma32]

	Frequency	User Spec	Specification
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4.0 CONFIGURATION

				+25°C	-15°C~+65°C	-15°C~+85°C
Wideband Signal	420 to 2170 MHz + 2620 to 2690 MHz	Insertion Loss	1.0 dB max	1.0 dB max	1.3 dB max	1.3 dB max
		V.S.W.R	1.4:1 MAX	-	-	-
		Attenuation	2.4~2.5GHz : >20dB 5.15~5.825GHz : >25dB	2.403 ~ 2.471GHz : >20dB	same	same
3 channels 2,4G WLAN (b/g standard)	2412 ± 9 MHz 2437 ± 9 MHz 2462 ± 9 MHz	Insertion Loss	3.0dB max	3.0dB max	3.3dB max	3.4dB max
		V.S.W.R	1.4:1 MAX	-	-	-
		Attenuation	at f _c ±16MHz : >25 dB at f _c ±41MHz : >50 dB 100MHz~2170MHz : >60 dB 2620MHz~6GHz : >60 dB	-	-	-
3 channels 5G WLAN (a/h standard)	5190 ± 9 MHz 5310 ± 9 MHz 5775 ± 9 MHz	Insertion Loss	3.0dB max Target < 2.5dB	2.5dB max	2.8dB max	3.0dB max
		V.S.W.R	1.4:1 MAX	-	-	-
		Attenuation	at f _c ±40MHz : >20 dB (target > 25dB) at f _c ±100MHz : >50 dB 10MHz~5.1GHz : >60 dB 5900MHz~6GHz : >60 dB	at f _c ±40MHz : >20 dB (target > 25dB)	20dB min	20dB min

Table X.X: TBD...

From Input□	Towards Input□	Isolation□	Frequency Band□
WLAN input b/g_(n) n=1,2,3□	WLAN input b/g_(m) m≠ n□ WLAN input a_(k) k=1,2,3□	> 25 dB > 50 dB	2 GHz channels□
WLAN input a_(k) k=1,2,3□	WLAN input a_(l) l≠ k□ WLAN input b/g_(n) n=1,2,3□	> 50 dB > 50 dB	5 GHz channels□
WLAN input b/g_(n) n=1,2,3□	GSM/OBCE input□	> 25 dB	2 GHz channels□
GSM/OBCE input□	WLAN input b/g_(n) n=1,2,3□	> 60 dB	420 - 2170MHz 2620 - 2690MHz□
WLAN input a_(k) n=1,2,3□	GSM/OBCE input□	> 25 dB	5 GHz channels□
GSM/OBCE input□	WLAN input b/g_(n) n=1,2,3□	> 60 dB□	420 - 2170MHz 2620 - 2690MHz□

Table X.X: TBD...

4.0 CONFIGURATION

4.54.3.2 Power

The Combiner equipment should be powered either by 115 V AC single phase power or 28V DC power. The 115 V AC power should be variable frequency as defined by **ARINC Report 609**: Design Guidance for Aircraft Electrical Power Systems.

The aircraft ac power supply characteristics, utilization, equipment design limitations, and general guidance are set forth in **ARINC Report 413A**: Guidance for Aircraft Electrical Power Utilization and Transient Protection, and **ARINC Report 607**: Design Guidance for Avionic Equipment for Category (A) utilization equipment.

The RF combiner should be compliant to ARINC 600 power dissipation and cooling requirements.

COMMENTARY

Equipment designers should take precautions to prevent anomalous operation of equipment during and after interruptions or transients in the aircraft power system. If the equipment shuts down during a power interruption, normal operation should resume without the need to recycle circuit breakers or clear memories when power is restored.

The system should be designed to implement a clean shutdown sequence upon power outages that exceed the system's tolerance. The shutdown sequence should be designed to prevent data loss or file corruption.

4.5.14.3.3 Batteries

No batteries should be used in UWDS components.

4.6 Environmental Conditions

~~The hardware components of the UWDS should be built to conform to the requirements of the latest applicable version of RTCA DO-160/EUROCAE ED-14: Environmental Conditions and Test Procedures for Airborne Equipment.~~

4.74.3.4 Grounding and Bonding

4.0 CONFIGURATION

Refer to Section 3 of ARINC Specification 600 and Appendix 2 of ARINC Specification 404A on the subject of equipment grounding and bonding.

The specifically applicable documents are defined by aircraft manufacturers and/or regulatory authorities.

~~Also refer to Airbus Directive ABD0100.1.8 and Boeing requirements BAC5117 and D6-82755.~~

4.3.5 Environmental Conditions

The hardware components of the UWDS should be built to conform to the requirements of the latest applicable version of RTCA DO-160/EUROCAE ED-14: Environmental Conditions and Test Procedures for Airborne Equipment. The specifically applicable documents are defined by aircraft manufacturers and/or regulatory authorities.

4.84.4 Built-In Test and Monitoring Considerations

In order to **provide adequate**~~be compatible with~~ Built In Test **results**~~requirement~~, the following description show some feature that RF Combiner could provide.

The Built In Test & Monitoring function :

- **Self test status**
- ~~- A self test function at power on,~~
- **Power on self test status**
- ~~- A Reset function [SHR33]~~
- **Power status,**
- ~~— External discrete output/input interfaces~~
- ~~— Discrete commands.~~
- ~~— A function to keep the RF output power at a well defined level.~~

The BITE could operate in different modes-:

- **BIT performed during Power-On (“PBIT”)**
- **BIT performed during operation (“CBIT”)**
- **BIT performed after Reset (“IBIT”)**

BITE results are reported to:

- **Discrete outputs**
- **SNMP over Ethernet**

~~— Test mode used onboard for :~~

4.0 CONFIGURATION

- ~~fault and status reporting / synthesis or detailed report~~
- ~~reporting a snapshot reflecting the equipment state on identified event or upon manual request,~~
- ~~reading equipment HW/SW configuration~~
- ~~downloading identifier like identifier of the cabin configuration.~~
- ~~sending commands (Reset, Channel n On/Off, ...)~~
- ~~Shop mode used at shop level for downloading HW/SW identifiers or for entering parameters (threshold, calibration values, ...) or for maintenance (module replacement)~~
- ~~Engineering mode used for reporting detailed monitoring~~

Commands received:

- SNMP commands received
-
- “Reset” and “
- Channel_n ON/OFF” (n = 1, ...6)
-
- Commands for setting the RF Combiner in different modes, [JRL34]
-
- Commands associated with the different modes
- ,

Channel activation / inhibition:

In normal operation, channels of the RF Combiner can be powered off when the corresponding CWLUs are OFF. Channels can be powered on when corresponding CWLUs are operating. Channels are powered off again when no burst have been detected. [Ma35]

Commands received via discrete signals are :

- Reset “**RESET**”,
- Pin programming
-

Informations sent via discrete can be :

- Built In Test status “**SELFTEST**”
- Power-On self test “**POS**”
- RF Combiner ON-OFF :”**POWER STATUS**”
- ... [SHR36]

4.0 CONFIGURATION

ARINC 763 refers to discrete pins as in input/output levels / impedance / max capacitance etc this unit should comply.

I think the BITE will require more detail if a manufacture wants to comply with the BIT interface. Other ARINC specification have an Attachment for detailing the interface (e.g. ARINC 781 Att 5)

[Ma37]

Complete Chapter needs to be detailed! Action for ELTA.

Maximum input power for passive OMTS I/F and the active WIFI ports — covered above

Action-ELTA: Define the maximum power levels for the active and passive ports (OMTS/WLAN) — 12 Watts Maximum into [SHR38] OMTS seems OK to me

Minimum input power (for automatic gain control) -> only for the active WIFI path — I think this is now addressed

IEEE compliance for WIFI outputs to be stated — still needs update to reference the correct standard [SHR39]

Insertion loss/gain -> losses for the passive path over the whole frequency band (flatness!)

Return loss -> Action for ELTA — Still needs update

Supported frequency bands -> Supported frequency bands WIFI and frequency range of passive path — Frequency band covered for OMTS required e.g. 400-3000MHz

Isolation/separation between frequency bands — Still need this I believe

Number of combiner inputs/outputs -> to be detailed and linked to the supported frequency bands. — Waiting input as discussed e.g. 400MHz to 3000MHz for the OMTS input along with insertion loss over the frequency band. [SHR40]

4.0 CONFIGURATION

Linearity (see IEEE compliance) – **there should be no degradation of the GSM or NCU as signals as it passes through the UWBS.**

Noise figure (obsolete for passive path) - **OK**

Spurious emissions (tbc by Areomobile) – **If the OMTS is completely passive then there should be no intermodulation products generated but there should be a statement as above saying that the NCU**^[Ma41]

ARINC 821 to read BIT results using SNMP – Steve's comments

ATTACHMENT 1
SYSTEM INTERFACES

ATTACHMENT 1 SYSTEM INTERFACES

1.1 OMTS Compatibility Interface Description

Figure 1-1 depicts the maximum OMTS configuration and its associated connections to the aircraft. The OMTS interface should be provisioned in the aircraft to provide one standardized interface that can be connected to by any OMTS supplier. Certain connections, including those listed as optional, may not be required depending on the specific supplier architecture or airframe implementation.

Additional system components have been included in the maximum aircraft interface configuration shown in Figure 1-1. Interconnections to any of these components should be considered optional as they depend on system implementation.

COMMENTARY

Multiple OMTS designs exist today that vary widely in implementation. OMTS designs are the result of specific assumptions about and measurements of the RF environment within aircraft cabins that could vary from one aircraft type to the next. No single OMTS design today is appropriate across all aircraft types. Airframe manufacturers and system integrators are encouraged to install this OMTS common interface to provide airlines with wiring compatibility to support installation of OMTS from different manufacturers.

OMTS interface compatibility was achieved by evaluating each of the available OMTS designs and deriving the system common signals and worst case wiring. The OMTS aircraft interface captures the maximum (worst case) wiring such that an aircraft wired to this interface can accommodate any of the OMTS systems available.

**ATTACHMENT 1
SYSTEM INTERFACES**

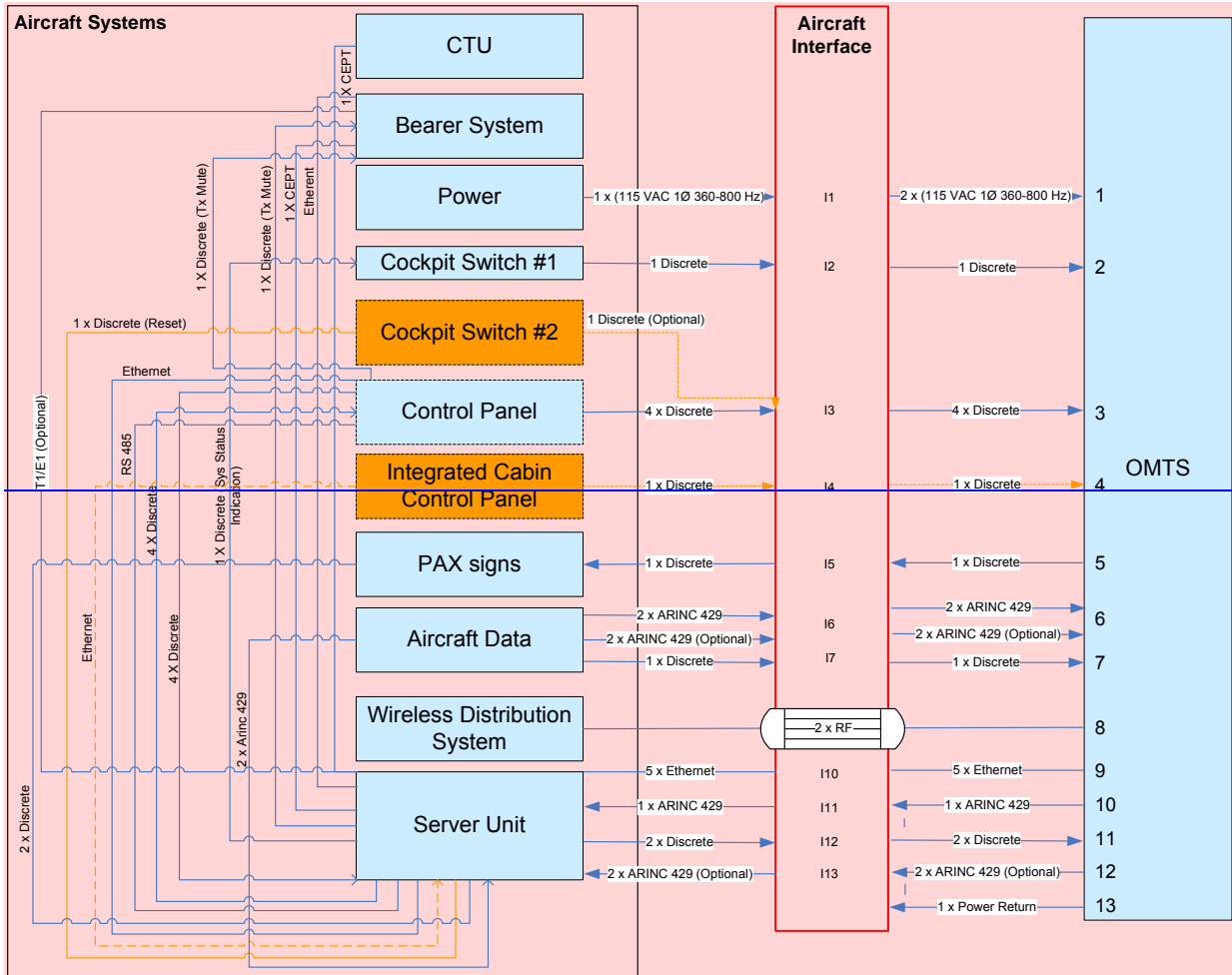


Figure 1-1 – OMTS Maximum Aircraft Interface

[Ma44]

**ATTACHMENT 21
RACK-MOUNTED EQUIPMENT DEFINITION**

ATTACHMENT 2 ATTACHMENT 1 EQUIPMENT AND INSTALLATION DEFINITION

2.11.1 LRU Physical Attributes

~~UWDSOMTS~~ rack-mounted components are based on standardized ~~62~~MCU LRU packaging concept. ~~In this concept each OMTS component (BTS, NGU and RFC) would be housed in a separate 2MCU LRU.~~

COMMENTARY

~~OMTS rack-mounted components are derived from the common 2MCU network component family defined in ARINC 763A. While physical, electrical and connector information from ARINC 763A has been included in this attachment, the reader is encouraged to refer to ARINC 763A for recommended LRU functions and ARINC 821 for Network Services to ensure compatibility with other aircraft network components built to the ARINC 763A Characteristic.~~

[Ma45]

~~Economies of design could result by combining the NGU and RFC into an Integrated NCU (I-NCU) that shares RF filters and combiners and therefore exhibits improved RF performance over separate packages. It is highly unlikely that an I-NCU could fit into a 2MCU LRU and a 4 or 6MCU package may be considered instead. If a larger I-NCU is implemented it should still comply with the rear connector and index keying defined herein to maximize rack and cabling commonality and reuse.~~ [Ma46]

~~The various OMTS LRU form factors are described in Table 3-1.~~

Table 3-1 – Rack-Mounted LRU Weights and Dimensions

RF-Combiner	-
Width	190.5 mm
Depth	358.9 mm
Height	194 mm
Weight	9.5 kg
-	-

[Ma47][Ma48]

**ATTACHMENT 21
RACK-MOUNTED EQUIPMENT DEFINITION**

2.21.2 Equipment Cooling

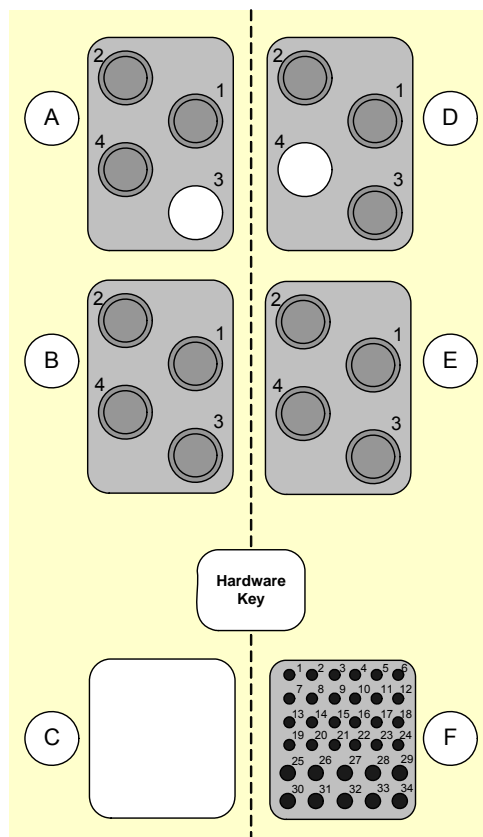
Rack-mounted **OMTSUWDS** components are expected to use ARINC 600 forced air cooling. **OMTSUWDS** components should be capable of accepting cooling airflow from either bottom-to-top or top-to-bottom for maximum installation choices by the systems integrator. The possible use of **OMTSUWDS** rack-mounted components in generic pre-wired trays dictates that a metered plenum should be used within each unit to restrict the amount of cooling air to that required for that specific **OMTSUWDS** component.

The **maximum** power dissipated within the LRU **is defined in attachment 12 of ARINC 600**. ~~should be limited to the values shown in Table 3-3.~~ For rack-mounted LRUs the pressure drop at the design flow rate from inlet to exhaust must be 50 ± 30 Pa (5 ± 3 mm of water) under standard conditions of 101.3 k Pa. (1013.25 m bars), per ARINC 600.

2.31.3 LRU Connectors

All **UWDSOMTS** rack-mounted LRUs utilize a single ARINC Type 2 connector. The types of inserts used in each LRUs connector are based on LRU functionality and are designated by the unit's index keying.

All **UWDSOMTS** rack-mounted LRUs use a common lower insert for power, RF and control discretes. The lower insert is Arrangement 04 per Attachment 19 to ARINC 600. [Ma49] Pin definitions for the lower insert are provided in Table 3-2. [Ma50]



ATTACHMENT 21
RACK-MOUNTED EQUIPMENT DEFINITION

Figure 3-1 – Rack-mounted Rear Connectors

Table 3-2 [Ma51] – **Connector Pin Assignment Insert A**

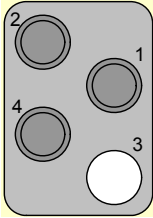
Quad Contact	Signal Name
	
A1	IEEE 802.11 a/h Tx2
A2	IEEE 802.11 a/h Tx3
A3	Not used Spare
A4	IEEE 802.11 a/h Tx1

Table 3-X – **Connector Pin Assignment Insert B**

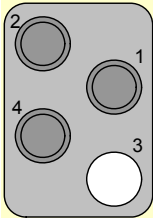
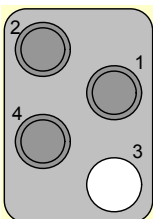
Quad Contact	Signal Name
	
B1	IEEE 802.11 b/g Tx2
B2	IEEE 802.11 b/g Tx3
B3	OMTS / Broadband Tx
B4	IEEE 802.11 b/g Tx1

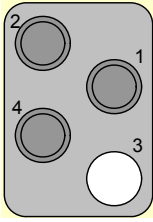
Table 3-X – **Connector Pin Assignment Insert D**

Quad Contact	Signal Name
	
D1	IEEE 802.11 a/h Rx2
D2	IEEE 802.11 a/h Rx3

**ATTACHMENT 21
RACK-MOUNTED EQUIPMENT DEFINITION**

D3	IEEE 802.11 a/h Rx1
D4	Not Used Spare

Table 3-X – Connector Pin Assignment Insert E

Quad Contact	Signal Name
	
E1	IEEE 802.11 b/g Rx2
E2	IEEE 802.11 b/g Rx3
E3	OMTS / Broadband Rx
E4	IEEE 802.11 b/g Rx1

Commentary

The design of the combiner should be according the signal definitions of the tables above. Additional uses of these pins may be identified for other applications.

Connector / Pin	Function
F01	Ethernet Rx Hi (Server Side)
F02	Ethernet Rx Lo (Server Side)
F03	Ethernet Tx Hi (Server Side)
F04	Ethernet Tx Lo (Server Side) <small>[JRL52][SHR53]</small>
F08	Discrete out (Selftest)
F09	Discrete in (Reset)
F10	Discrete out (Power Status)
F11	Discrete out (POS) <small>[SHR54]</small>
F14	Spare discrete
F15	Spare discrete
F16	Pin Prog.
F17	Pin Prog.
F18	Pin Prog. <small>[SHR55]</small>
F19	Spare (DSI)
F20	Spare (DSI)
F21	Pin Prog.
F22	Pin Prog.
F25	115VAC in
F27	Ground
F29	115VAC out
F30	28VDC in

**ATTACHMENT 21
RACK-MOUNTED EQUIPMENT DEFINITION**

F32	Ground
F34	28_VDC return [Ma56]

Table 3.X Pin Assignment Connector F

2.41.4 Index Keying

Plug connector index posts and receptacle connector keyways are defined in ARINC Specification 600. [Six possible positions are numbered 1-6.](#)

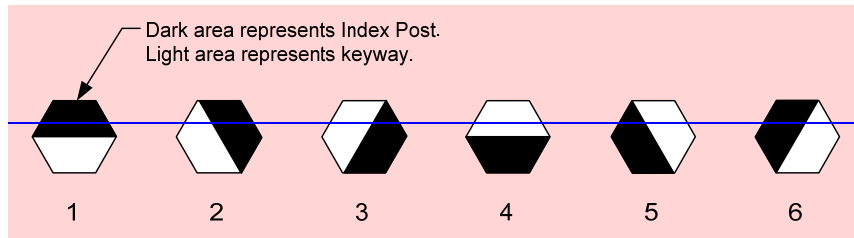


Figure 3-2 [Ma57] – ARINC 600 Receptacle Connector Key Polarization Positions

OMTS components treat the position of index posts and connector keyways with unique purpose. Index posts and keyways retain their traditional definition as detailed in ARINC Specification 600. In addition, a seventh keyway value is assigned on the LRU, defining the lack of a definitive connector keyway as position 0. Thus, seven connector keyway positions are shown in Figure 3-3, looking at the rear of the unit.

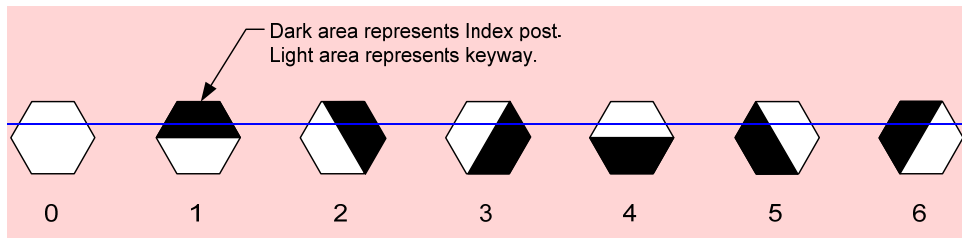


Figure 3-3 – Receptacle Connector Key Polarization Positions

Each keyway represents an insert type in the LRU. The Left keyway represents the type of connector in the upper insert; the center key way represents the connector type in the middle insert and the right keyway represents the presence of RF connectors in the lower insert. Refer to ARINC 763A for a detailed description of the insert/keyway relationship. Table 3-5 defines the Index Keys for each OMTS equipment type.

Table 3-5 – OMTS Index Key Positions

Component	Left Key	Center Key	Right Key
BTS	0	1	1
NCU	0	1	1
RFC	3	2	1
INCU	3	1	1

ATTACHMENT 21 RACK-MOUNTED EQUIPMENT DEFINITION

The polarization positions for connector keyways on the OMTS components are shown in Table 10 of ARINC 763A. As an example the BTS Index pins are illustrated in Figure 3-4. The lack of a keyway (position 0) in the left index key indicates that the BTS has a blank upper insert. The center keyway in position 1 indicates the BTS has a Quadrax middle insert. The right keyway in position 1 indicates that the BTS lower insert includes RF connections.

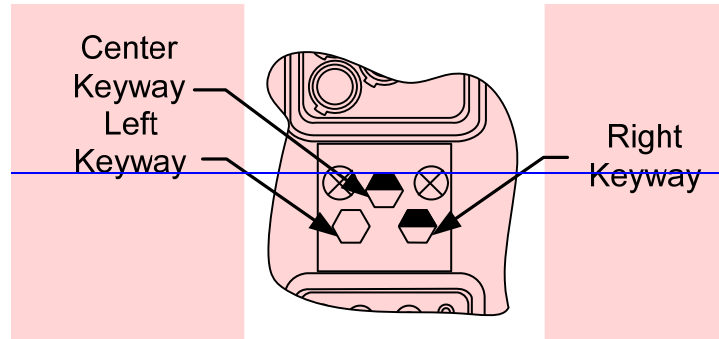


Figure 3-4 – Index Key example – BTS [Ma58]

2.5 Installation – RF Combiner

The Arinc 600 specification needs to be respected (e.g. air cooling, pressure drop). If an standardized Arinc 600 rack is not available it may be possible to define a customized receptacle to install the unit. [JRL59]

Comment Installation guide line

Active Combiner needs air cooling due to dissipation of active devices. In order to achieve a thermal balance compatible with Combiner electronic design the ARINC 600 specification will be followed specially against air cooling limitation (e.g air cooling flow limitation, minimum pressure drop).

Due to the number of RF interconnection at ARINC 600 connector interface, the racking needs a significant insertion force. This step needs to be carried out with attention because RF losses may be impacted if the racking is not conducted properly.

As described in §3.2 connections to antenna are dispatch by N or TNC [JRL60] connector, to control RF losses it is mandatory to torque N or TNC with the level required by connector supplier. When torque operation is completed it needs to secure by wire blocking.

[Ma62]

2.61.5 Installation – Broadband Antenna

For the installation of the broadband antennae, the following points need to be considered:

ATTACHMENT 21
RACK-MOUNTED EQUIPMENT DEFINITION

- Metallic planes and parallel metallic bars close to the Leaky Line Antenna may have a negative effect on the antenna efficiency. Usually a distance of approx 50mm between the radiating coax and the metallic surface is sufficient.
- Metallic structures crossing perpendicular to the radiating coax have minor impact.
- The line of sight between the radiating coax and the potential client device should be as RF-transparent as possible. Note that not only metallic structures may have an impact, but also carbon composite and water (for 2.4GHz).
- Avoid deformation of the Leaky Line Antenna (e.g. at the mounting points) as this may lead to impedance changes increasing reflections in the cable and therefore increasing its insertion loss.

**APPENDIX A
ACRONYMS AND ABBREVIATIONS**

APPENDIX A ACRONYMS AND ABBREVIATIONS

A/C	Aircraft
AEEC	Airlines Electronic Engineering Committee
AWG	American Wire Gauge
BIT	Built-In Test
BITE	Built-In Test Equipment
BSC	Base Station Controller
BTS	Base Trans-receiver Station
CCS	Cabin Communications System
CDMA	Code Division Multiple Access
CEPT	European Conference of Postal & Telecommunications Administrations
CIDS	Cabin Intercommunication Data System
CMM	Component Maintenance Manual
CMRS	Commercial Mobile Radio Service
CRC	Cyclic Redundancy Checking
CTU	Cabin Telecommunications Unit
CWLU	Cabin Wireless LAN Unit
ECC	Electronic Communication Committee
ED	
EDGE	Enhanced Data rates for Global Evolution
EUROCAE	
EVDO	Evolution Data Optimized
FBO	Fixed Base Operator
GPRS	General Packet Radio Services
GSE	Ground Support Equipment
GSM	Global System Mobile
ICAO	International Civil Aviation Organization
IFE	In-Flight Entertainment
INCU	Integrated Network Control Unit
IR	Infrared
ISDN	Integrated Services Digital Network
LAN	Local Area Network
LRU	Line Replaceable Unit
MCU	Modular Concept Unit
MS	Mobile Station
MTBF	Mean Time Between Failures
MTBUR	Mean Time Between Unscheduled Removals
NCU	Network Control Unit
NFF	No Fault Found
NSS	Network Server System

APPENDIX A
ACRONYMS AND ABBREVIATIONS

OMTS	On-Board Mobile Telephony System
PAX	Passenger
PEDs	Portable Electronic Device
RF	Radio Frequency
RFC	RF Combiner/Splitter
RX	Receive
SSA	??
T-PED	Intentionally Transmitting Portable Electronic Device
SE7	Spectrum Engineering Working Group 7
TFTS	Terrestrial Flight Telephone System
TWLU	Terminal Area Wireless LAN Unit
TX	Transmit
WOW	Weight-On-Wheels