APPENDICIES

1.0 INTRODUCTION

1.1 Purpose and Goal

The purpose of ARINC 667 is to provide guidance for the in-service management of Aircraft Controlled Software, which is also called Field Loadable Software (FLS) or Loadable Software Parts. All of these terms are considered equivalent. The following is the evolution of these loadable software terms:

- First, the term Field Loadable Software (FLS) implied all aircraft software that is loadable on the aircraft or in the shop. It focused on loadable characteristic of the software.
- Second, the term Loadable Software Part (LSP) also implies all aircraft software that is loadable on the aircraft or in the shop. However, it focuses on describing the software being an aircraft part and secondarily on the fact that it is loadable.
- Currently, a more precise term is Aircraft Controlled Software (ACS), which describes how aircraft software is controlled regardless of how the software is loaded.

ARINC Report 667 generally uses the term ACS to describe the software in the scope of this document. The term FLS is used sparingly.

Modern airplanes contain two distinct types of software: Aircraft Controlled Software (ACS) and Hardware Controlled Software (HCS). ACS are independent airplane parts that must be managed separately from the hardware. The management of HCS is not discussed in the document since existing hardware management processes can be applied to HCS. Further definition of airborne software types is contained in Section 2.0. Refer to **ARINC Report 849:** *Data Loading Specifications for Aircraft Components* for more information about HCS.

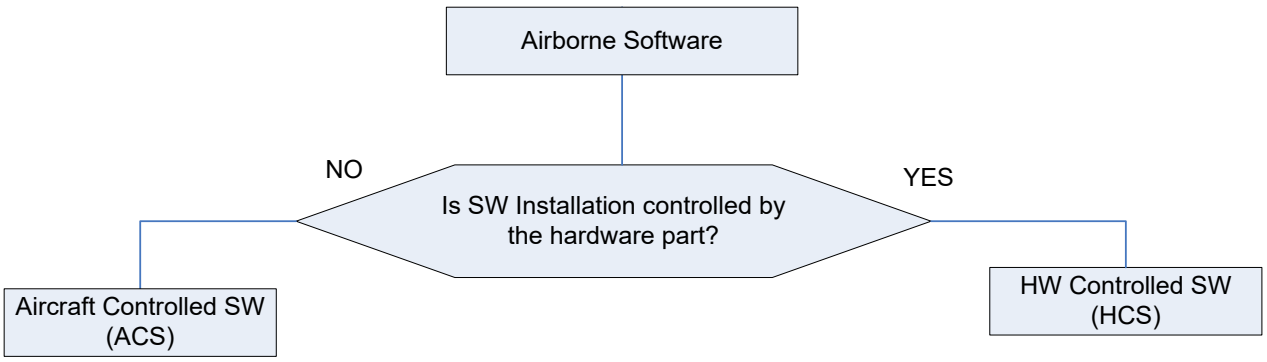


Figure 1-1 – Airborne Loadable Software

This document is intended to be broad and apply to all Aircraft Controlled Software (ACS). The key features of Aircraft Controlled Software are as follows:

a. Usually capable of software loading on-aircraft and off aircraft.
b. Software part number is electronically verifiable on-aircraft.
c. Modification does not change target hardware part number.
d. The software has its own unique identification/part number.
e. The software part may be a type-certified aircraft part.

f. The software may be an application.
g. The software may be a database.

COMMENTARY

The term target hardware refers to the unit or system that is intended to host the software. The terms Line Replaceable Unit (LRU) and Line Replaceable Module (LRM) are used sparingly in this document, as they are both considered target hardware.

1.2 Vision

The following sections describe the vision, scope, and background leading the preparation of this document.

As a basic premise, airlines desire processes and guidelines that will assure that the correct ACS is loaded into the target hardware on every aircraft or training device at all times. These guidelines are prepared for the airlines, airframe manufacturer, hardware, and software providers. Airlines want to ensure that handling of ACS in the parts supply chain is efficient, cost effective, and appropriate.

COMMENTARY

The term “airline” is used throughout the document to include the aircraft operators and anyone else that operates on their behalf, e.g., Maintenance, Repair, and Overhaul (MRO) Service providers and other airline designees such as training providers or training device manufacturers.

1.2.1 Scope

This document provides guidance to users of ACS for the development of methods to control and manage ACS. Ideals contained within this document were developed from past experiences and future expectations based on the business situations and maintenance actions of contributing aircraft manufacturers, airlines, Original Equipment Manufacturers (OEM), vendors, and software suppliers.

This document defines Aircraft Support Data (ASD) in Section 2.0. ARINC 667 does not define management processes for ASD. Guidance for management of ASD is contained in **ARINC Report 675:** *Guidance for the Management of Aircraft Support Data Management*.

As aircraft and their components become more reliant upon software to operate, it is imperative that actions must be taken to maintain control and management of aircraft software. Different OEM installations, multiple vendor/supplier interfacing units, and varying operator requirements for data upload and retrieval have proven to be difficult integrations of the in-field software control. It is the clear intention of this document to provide a means to encourage good software configuration control and management practices.

The following diagram depicts the major processes described by this report.

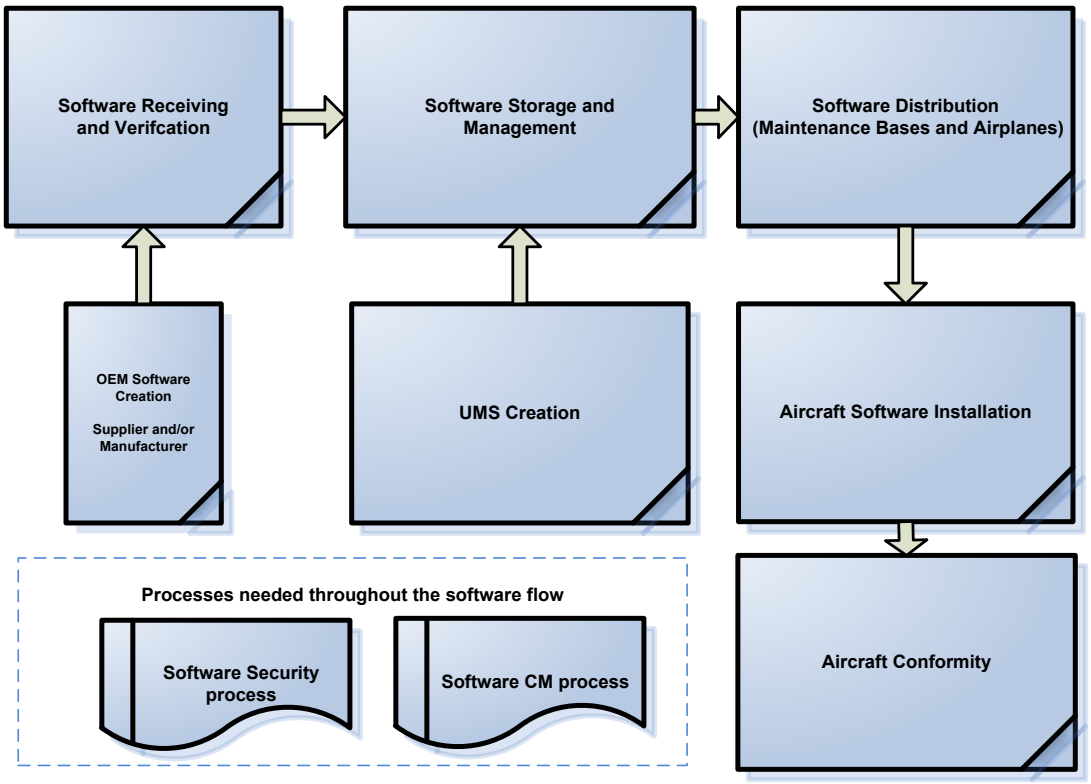


Figure 1-2 – Software Processes in Software Distribution

1.2.2 Background

In the past, airlines developed their own methods of controlling ACS in an environment where the universally accepted principles and guidelines on how ACS should be handled did not exist. Users often developed a set of rules that differ from one to another.

The benefits of onboard software loading were frequently obscured by the logistical problems created in managing ACS. The industry felt that a common approach described in this document is useful and necessary. As a result, ARINC Report 667 was created to meet the needs of the airlines standardizing the definition, terminology, and software configuration control and management.

1.3 The Fundamentals of ACS Management

The use of ACS has many advantages but also requires unique processes. Certain fundamentals of ACS must be understood before detailed processes can be developed.

1.3.1 Need for Aircraft Configuration Management

ACS requires rigorous configuration management since much of the software can affect aircraft safety. The aircraft operator must ensure that an aircraft has both the correct hardware and the correct ACS in order to safely dispatch an aircraft.

Well defined ACS configuration management processes are required for the operator to maintain continuing airworthiness. The operators' ACS configuration

management processes should be documented. They also may need to be reviewed by operational regulatory authorities.

Configuration control of ACS is maintained at the aircraft level. Software designated as ACS must be installed and verified as a separate activity from installing and verifying the hardware which contains the ACS.

It is not the purpose of this document to specify exactly how airlines must accomplish configuration management, but there are a number of standard practices that should be used for setting up configuration management of ACS. For example, it is essential to have a clear definition of the authorized software configuration for each aircraft. Configuration management guidelines for ACS are fully described in Section 8.0.

1.3.2 Software Part Numbers

Aircraft Controlled Software (ACS) is uniquely identified by a software part number and thus can be referred to as an Aircraft Controlled Loadable Software Part (ACLSP). This software part number is used as the basis of aircraft software configuration control. The software part number uniquely identifies the bit image of the binary file, which resides in the memory of the target hardware and will thereby influence the operation of the target system.

Any variation of the software should be accompanied by the assignment of a new ACLSP part number. It is not acceptable for new versions to retain the original part number.

It is not unusual for the target hardware to contain several ACLSPs such that its software configuration may comprise a number of software part numbers. This typically permits segregation of software of different types, e.g., executable code as distinct from databases or segregation of software parts of different certification levels.

Standard part number formats are defined in **ARINC Report 665:** *Loadable Software Standards*.

1.3.3 Media Set Part Number

When ACLSPs are stored and distributed on physical media, e.g., floppy disks, CDs, flash drives, etc., the media which contains the ACLSPs will have its own media part number which is distinct from the ACLSP part number. Media use and media parts are discussed further in Section 6.0.

1.3.4 Hardware Part Numbers

The fact that loadable software is managed as a separate entity means that the part number of the target hardware does not provide any information on the ACLSP configuration loaded into the unit. The target hardware part number should not be changed when new ACLSP part numbers are created and loaded.

COMMENTARY

Exceptions exist in hardware and software configurations where the software updates change the dash number of the hardware part number yet are controlled as an ACLSP. This report does not invalidate this condition; however, future designs should avoid this situation.

COMMENTARY

As the phrase “onboard loadable” implies, software parts may be loaded into target hardware while the hardware is installed on the aircraft. However, most line maintenance facilities do not possess the capability to alter a hardware part number on-aircraft. Identification of the target hardware is typically performed at the component maintenance shops. Software loads that change the target hardware part number, therefore, often requires removing the target hardware from the aircraft and returning it to the maintenance shop.

The design of modern aircraft hardware utilizes processor modules that may serve multiple functions. The actual functionality of the target hardware is determined by the installed ACLSP. The concept of a single function for a single box is replaced by the concept of multiple, programmable functions. This type of design philosophy reinforces the premise that the target hardware part number is independent of the ACLSP.

1.4 Basic Rules for ACLSP

The use of ACLSPs has many advantages but requires a few basic rules to be observed. While these may appear to be self-evident, there have been a number of examples where logistical difficulties have resulted from deviating from these fundamentals.

1.4.1 Aircraft Level Configuration Control

Configuration control is maintained at the aircraft level. Software (the bit image) designated as an ACLSP is an aircraft part and is identified as such by unique software part number. ACLSPs require control independently of their target hardware. The target hardware may have more than one loadable software part.

1.4.2 Replacement of Hardware Parts On-aircraft

When replacing hardware parts, it is necessary to verify the ACLSPs installed in the new target hardware against the approved aircraft configuration. If the ACLSPs of the unit are not the approved configuration, the correct software must be loaded.

1.4.3 Spare Target Hardware

Software that is preloaded in spare target hardware is not required to be under approved aircraft configuration. Pre-loading with software is a common practice to minimize task time on the aircraft. Target hardware serviceability is independent of the ACLSPs loaded. The ACLSPs in the spare hardware become significant when the hardware is installed in an aircraft because hardware and software is being installed on the aircraft and both must be verified to be correct.

1.4.4 Aircraft System Function

Because the target hardware part number is independent of loaded ACLSPs, Aircraft system function is no longer a function of hardware part number alone but depends on the combination of target hardware and ACLSPs. The serviceable tag on target hardware does not cover serviceability of ACLSPs.

1.4.5 Target Hardware Loadability

Target hardware should always be loadable irrespective of the existing ACLSP configuration. If there are circumstances, either by design or in error, where a certain ACLSP configuration inhibits the ability to load other ACLSPs, then the target hardware cannot be considered to be onboard loadable. In such cases, the only reasonable course of action is to distinguish between hardware with the different pre-loads by different hardware part numbers.

Target hardware, software, or loading process should be robust enough to accept earlier versions software part numbers or allow in airplane software rebuilding from scratch. Units that have pre-loaded software installed may need to be loaded with an older software part number to match the proper configuration of the aircraft.

1.4.6 Logistics of Spare LSPs

Aircraft software configuration is defined by ACLSP part numbers. ACLSPs can be transported on several types of media or transferred electronically. Spare LSPs transported on a software medium are often managed within the supply chain by reference to the Media Set Part number rather than the software part number.

1.4.7 Electronic Transfer of Software

Electronic transfer of software enables the movement of ACLSPs without the need for a physical media set. ACLSPs may be transferred directly from an aircraft manufacturer or a software supplier to the airline using electronic means, then transferred to the aircraft. In this case, the ACLSP does not need a Media Set Part number. For further information on electronic transfer, refer to **ARINC Report 827:** *Electronic Distribution of Software by Crate (EDS Crate)*.

1.4.8 Physical Media Use

Several physical media types can be used to store and distribute LSPs. Current examples of physical media types used are floppy disk, DVD, CD-ROM, or PC Card.

Because the media contains aircraft parts, it is important to manage the media via the use of Media Set Part numbers or integrated media identification as explained further in Section 6.5, Media Packaging and Handling.

1.5 Mass Storage Device (MSD) Use

MSDs are an effective way to manage all types of software on the aircraft or in a shop environment. A MSD may be capable of holding the entire software library for an aircraft or fleet. Airlines desire the flexibility to manage airborne software using MSDs. It is essential that an MSD's content (ACLSPs and/or Media Set Parts (MSPs)) can be displayed in a way that will permit its contents to be managed.

1.5.1 Mass Storage Devices On-Aircraft

Onboard MSDs can serve many purposes including the storage of spare ACLSPs. The contents of such devices do not determine the correct ACLSP configuration for the aircraft systems concerned and more than one software part number for a given system may be carried for logistical reasons. Updates to the contents of MSDs may be accomplished on the aircraft by transferring ACLSPs from a portable media such as floppy disks, CDs, DVDs, etc., or via electronic transfer through an airplane-to-ground connection. Discontinued or obsolete ACLSPs should be deleted from these devices while installed on the aircraft, though the exact level of control of such parts in onboard MSDs is a matter for airlines to negotiate with their regulatory authorities.

However, in order to prove that obsolete parts are deleted, the same controls should be employed as for installed ACLSPs.

Where major changes to the aircraft ACLSP configuration are made, the MSD may be replaced with a preloaded MSD to reduce aircraft maintenance time, though the need for this is reduced on-aircraft where electronic distribution is implemented. These devices may contain ACLSP that is part of the aircraft configuration as well as other types of ACLSP. MSDs should have their own hardware part number and serial number which are independent of the ACLSPs stored on it.

1.6 Types of Aircraft Controlled Software

Federal Aviation Administration (FAA) order 8110.49 defines Aircraft Controlled Software as software that can be loaded without removal of the equipment from the installation. ACS can refer to either executable code or data (see RTCA DO-178B, Section 2.5). The important attribute of ACS is that its configuration is managed independent of its target hardware. Note that the term Field Loadable Software (FLS) is equivalent to the terms ACLSP and ACS.

This document encompasses all types of ACS, as described further in Section 2.0.

1.6.1 ARINC Documents

Throughout this document, several other ARINC Reports, Specifications, and Standards are referenced. In all cases, it is intended that the latest versions of the referenced documents apply. The following are examples of often referenced ARINC published standards:

- **ARINC Report 615:** *Airborne Computer High Speed Data Loader* defines ARINC 429-based software data loading protocols.
- **ARINC Report 615A:** *Software Data Loader Using Ethernet Interfaces* includes information on loadable software standards and it is intended that the information contained in this document should be complementary and use common terminology wherever possible.
- **ARINC Report 625:** *Industry Guide for Component Test Development and Management* includes information on developing test programs and documentation and provides guidance on fault isolation requirements.
- **ARINC Specification 641:** *Logical Software Part Packaging for Transport* defines the method of storing multiple formats of loadable software parts in a directory structure regardless of media type.
- **ARINC Report 665:** *Loadable Software Standards* includes information on such aspects as file formats, part numbering, transport media, and Cyclic Redundancy Check (CRC) calculation.
- **ARINC Report 666:** *Electronic Distribution of Software* defines how ACS can be distributed without using portable transport media. Such activities fall within the software configuration management processes defined in this document.
- **ARINC Report 675:** *Guidance for the Management of Aircraft Support Data* defines how non-certified data is used in air transport aircraft.
- **ARINC Characteristic 763:** *Network and File Server (ANFS)* defines the file server which has a role in the storage of loadable software on the aircraft and potentially the electronic reception of software parts transmitted via gatelink.

- **ARINC Specification 826:** *Software Data Loader Using CAN Interface* describes the use a Controller Area Network to load software into target hardware.
- **ARINC Specification 827:** *Electronic Distribution of Software by Crate (EDS Crate)* describes the principles and rules for electronic distribution of aircraft software and related content using a digital container referred to as an EDS Crate.
- **ARINC Specification 843:** *Aircraft Software Common Configuration Reporting* defines the process and format for generating a software configuration report from an aircraft or a mass storage device.
- **ARINC Report 849:** *Data Loading Specifications for Aircraft Components* defines the information required to implement a solution to load aircraft components when not installed aboard the aircraft. It intends to address all forms of data as related to component maintenance and repair.

1.6.2 Non-ARINC Documents

Throughout this document, several non-ARINC guidance documents are referenced. In all cases, it is intended that the latest versions of the referenced documents apply. The following are examples of documents not published by ARINC:

RTCA DO-178/EUROCAE ED-12: *Software Considerations in Airborne Systems and Equipment Certification* provides the principle basis for which software is developed and certified. These documents are technically equivalent. Most aviation authorities recognize these documents for this purpose, and they are referenced in such documents as Federal Aviation Requirement (FAR) 25 and EASA CS-25. At the time of writing, the current version is RTCA DO-178(). The certification level nomenclature was revised between versions A and B. The certification level referenced herein pertains to RTCA DO-178(). Reference to the issue number has been omitted unless it is relevant.

RTCA DO-200A: *Standards for Processing Aeronautical Data*. This document provides the minimum standards for processing aeronautical data used for navigation, flight planning, terrain awareness, flight simulators, and other purposes.

RTCA DO-201A: *Standards for Aeronautical Information* provides for the improved operational effectiveness of airborne navigation systems that use stored databases. It presents a collection of disciplines necessary to provide assurance that aeronautical information used by the aviation industry meets the high quality and integrity for safe flight.

RTCA DO-355/ED-204: Information Security Guidance for Continuing Airworthiness

FAA AC 119-1 – Airworthiness and Operational Approval of Aircraft Network Security Program (ANSP)

2.0 TYPES OF AIRCRAFT SOFTWARE AND DATA

2.1 General

This section attempts to classify all aircraft software and data in order to help aircraft operators manage it. While this specification focuses on management of ACS, this section classifies all aircraft data and software.

2.2 Determining Software Control and Loadability

The following diagram is used to determine if software is aircraft controlled or hardware controlled and whether software is loadable.

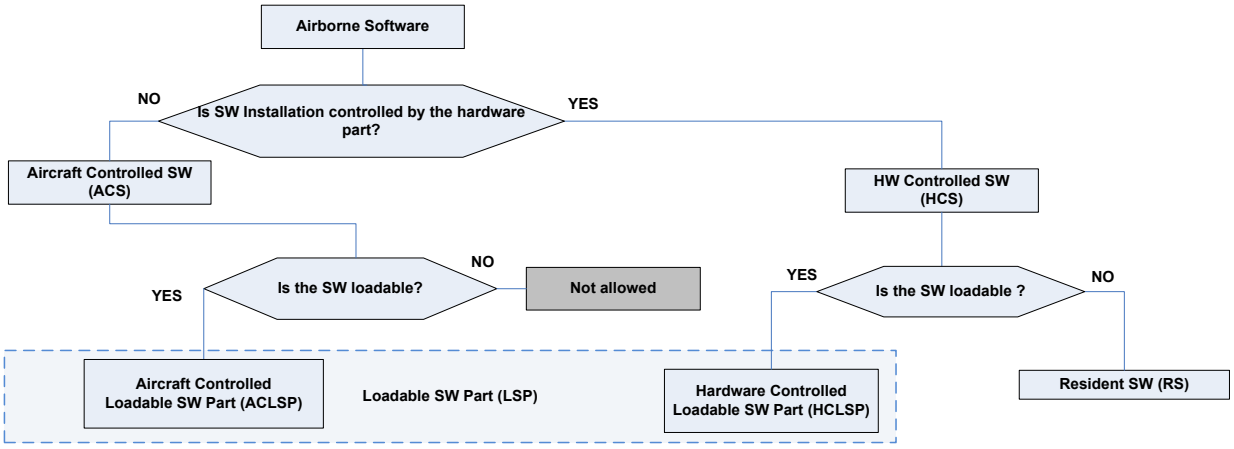


Figure 2-1 – Aircraft versus Hardware Controlled Loadable Software Parts

2.2.1 Aircraft Software and Data

Aircraft Software includes all software and data installed on the aircraft.

There is a functional subset of loadable software and data that does not affect Part 25 or Part 121 certification called Aircraft Support Data (ASD) that is defined in **ARINC Report 675:** *Guidance for the Management of Aircraft Support Data*.

2.2.2 Hardware Controlled Software

All aircraft software which is configuration managed by the hardware part number of the hardware which contains the software is considered Hardware Controlled Software (HCS).

ARINC Report 849: *Data Loading Specifications for Aircraft Components* describes shop loading processes for HCS.

2.2.2.1 Resident Software

Resident Software is HCS that is an integral part of the hardware (e.g., as when “burned” into memory) which cannot be changed without physically altering the hardware (i.e., disassembling the hardware; adding, changing, or removing physical parts of the hardware, etc.). This software requires installation in an authorized repair station and requires hardware return-to-service testing before the hardware can be released from the repair station.

2.2.2.2 Hardware Controlled Loadable Software Part

Hardware Controlled Loadable Software Part (HCLSP) is a Loadable Software Part (i.e., can be changed without physically altering the memory) which is configuration managed by the part number of the hardware which contains the LSP. This means that if an HCLSP is changed the hardware part number must change.

These LSPs can be distributed and managed separately from the hardware (i.e., can be changed without physically altering the Programmable Read Only Memory (PROM)) but must be loaded for the hardware to be considered ready for service. This software usually requires installation in an authorized repair station and may require hardware return-to-service testing before the hardware can be released from the repair station.

2.2.3 Aircraft Controlled Software

All software which is not configuration managed by a hardware part number is considered ACS. This software requires configuration control at the aircraft level and these parts are considered separate aircraft installations from the hardware which contains them.

2.2.3.1 Aircraft Controlled Loadable Software Part

ACLSP is an LSP which is controlled at the aircraft level, not configuration managed by a hardware part number. All ACS is required to be loadable and therefore all known ACS parts are also considered ACLSPs.

This term ACS is considered equivalent to FLS.

2.2.4 Loadable Software Part

Aircraft software which can be loaded into hardware without physically altering the hardware (i.e., disassembling the hardware; adding, changing, or removing physical parts of the hardware, etc.) and can be managed separately from the hardware by airframe manufacturers and airlines are considered LSPs. The terms HCLSP and ACLSP are used to distinguish the method of aircraft installation control.

COMMENTARY

There are a few instances where Aircraft Controlled Software is not able to be loaded in an aircraft environment. This should be avoided.

ARINC Report 849 addresses these corner cases.

2.3 ACLSP Software and Data Classification Tree

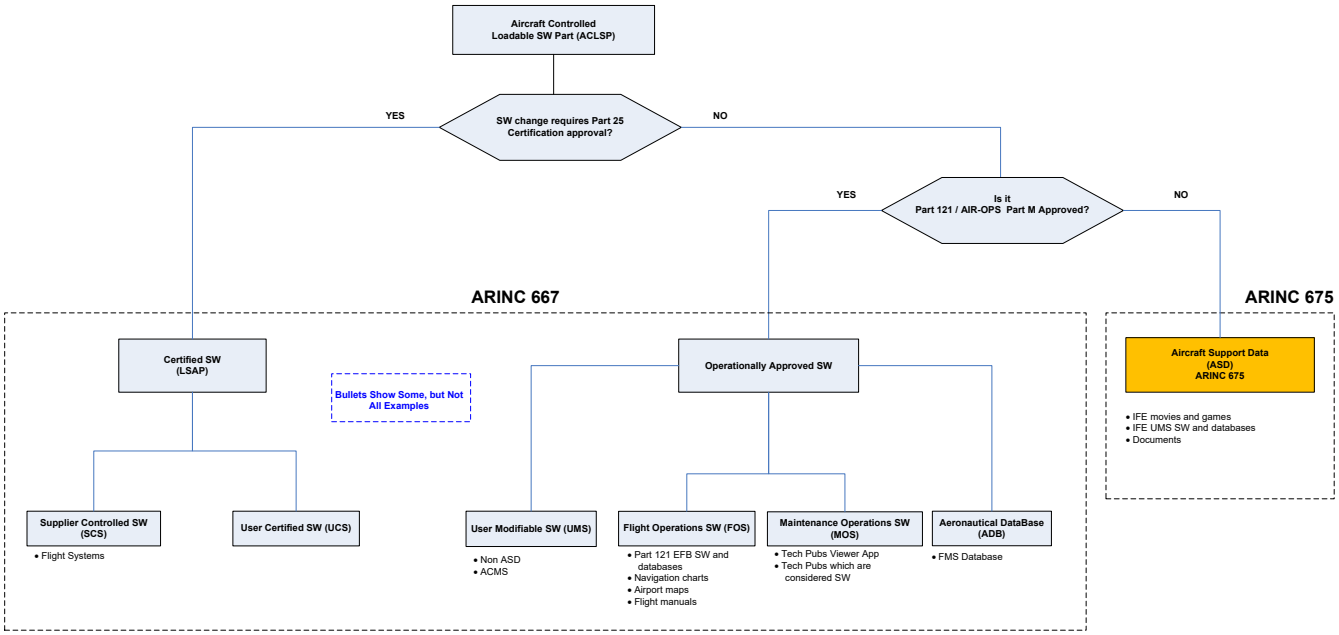


Figure 2-2 – Types of ACLSPs

2.4 Types of ACLSPs

The following paragraphs define and discuss the types in Figure 2-2.

2.5 Part 25 Certified Software (LSAP)

Certified Software is all ACLSPs which are airworthiness approved per FAA or EASA Part 25 regulations. Any changes to this software requires certification approval.

Certified Software regulatory requirements are found in:

- 14 CFR Part 21.31
- EASA Part 21 - § 21A.31
- 14 CFR Part 25.1301/1309
- EASA CS Part 25 - § 25.1301/1309

In addition, certified software is generally developed to the guidance contained in RTCA DO-178().

LSAP is certified software which is an ACLSP (loadable and ACS). The majority of loadable avionics software are LSAPs.

2.5.1 Supplier Controlled Software

The supplier of this type of software is the TC/STC holder or the developer of the software. Changes to Supplier Controlled Software (SCS) require approval by the certification authority. The following sections describe some, but not all types of SCS. The following types are most important to the airlines.

2.5.1.1 Operational Program Software

Operational Program Software (OPS) is the main operating functional software for a component. OPS should not be confused with flight operations software.

2.5.1.2 Option Selection Software

Use of OSS creates a method of accommodating customer options using software whereas this had been controlled by hardware program pins in the past.

The TC holder can define software selectable aircraft functions using Option Selection Software (OSS). OSS generally is composed of parameter data items as defined by RTCA DO-178().

COMMENTARY

OSS is an equivalent term for Operational Program Configuration (OPC). An example of OSS is Software Pin Programing (SPP).

2.5.1.3 Applications only Certified under Part 25.1309

Some Application Software may require both Airworthiness Certification and Operational Approval.

These types of application software, when used in an aircraft-installed system/unit, do require airworthiness approval under Part 25.1309. In this case, it is required to demonstrate that the application is not a source of danger in themselves and do not adversely affect the proper functioning of other equipment or system covered by type certification or by operating rules. The architecture of the airplane's systems is what determines if certification is required or not.

Nevertheless, this airworthiness approval covers neither the proper functioning nor the use of the application in the operation of the Aircraft.

The TC/STC holder is responsible for the airworthiness approval under Part 25.1309. The operator must check if the application requires operator regulatory approval, and is responsible for this operational approval when required.

An example of this software is the Airline Operational Control (AOC) application. The AOC defines the airlines' protocol for exchanging messages within their organization. The AOC system must not affect the operation or safety of the aircraft communication systems when installed on a certified platform.

2.5.2 User Certifiable Software

There are some situations where the aircraft operator modification of software is desired, but where it is not possible to avoid the need for certification authority review of the modifications. In these cases, the airline is obliged to follow appropriate certification rules. The term User Certifiable Software (UCS) is used in this document for the purposes of describing this type of software.

UCS is software that an airline or its designated party chooses to modify, usually following the guidelines of RTCA DO-178()/EUROCAE ED-12.

COMMENTARY

One example of UCS is the configuration database used in a cabin management system, which enables the airline to reconfigure such items as cabin lighting controls (smoking/seat belts signals) following a change of cabin seating layout. Such changes need to be achievable software swiftly, without reference to the manufacturer, to respond to ever-changing market conditions.

2.5.3 Software Design Assurance Levels

The impact of certification levels on the airframer and component supplier is primarily on the software development. The software Design Assurance Level (DAL) is determined by RTCA DO-178().

Even though a DAL of an instance of software could have a low impact on safety, the installation on the aircraft is important to consider. The functionality and amount of systems affected determines whether a modification of the airplane is major or minor.

Airlines require all information about a software change from the software suppliers to properly evaluate the effects of the change. The supplier should also codify the change by noting it as major or minor in a service bulletin.

Relatedly, operators desire software modifications to have a minimal impact as possible. The resources associated with major changes are proportionate.

In all cases, the impact to safety governs this consideration and decision.

2.6 Operationally Approved Software

Operationally Approved Software is software for which use or modification:

1. Does not require Part 25 airworthiness approval, and
2. Does require operator regulatory approval.

The operator has the responsibility to determine/agree with its regulatory authority which software fits this category. The operator has flexibility in defining which software fits this category if regulatory approval is not required.

This class of software will generally be managed with a process less rigorous than Part 25 Certified software and more rigorous than Aircraft Support Data (see Section 2.7).

2.6.1 User Modifiable Software

User Modifiable Software (UMS) is software intended for modification by the aircraft operator without review by the certification authority, the TC or STC holder, or the equipment manufacturer. Modifications by the user may include modifications to data or executable code, or both.

RTCA DO-178() makes provision for UMS by providing rules for the certification of systems that provide this flexibility, while ensuring that any such modifications do not impact the airworthiness of the aircraft. The principle is that the host system controls the scope of the user modifications. The nomenclature “User Modifiable Software” has been used in this document with the same meaning as in RTCA DO-178(). UMS needs to be declared as such by the TC or STC holder.

The aircraft operator needs to know if the software is user modifiable. It is the Type Certificate (TC) or Supplemental Type Certificate (STC) holder responsibility to notify the operator what software is user modifiable.

See Section 3.0 for more information on UMS.

2.6.1.1 Aeronautical Databases

Aeronautical Databases (ADB) are a form of Operationally Approved Software which have unique configuration management processes and regulatory status.

COMMENTARY

Aeronautical Databases may be configuration managed separately from other ACLSPs.

RTCA DO-200A/EUROCAE ED-76 and DO-201 define aeronautical data used for applications such as navigation, flight planning, flight simulators, terrain awareness, and other purposes. Navigation, terrain, and obstacle data are examples. Aeronautical data is used by such systems as Flight Management Systems (FMS) and Terrain Awareness and Warning System that depend on data describing external factors such as airspace designations, runway locations, and lengths. This data is subject to change and may be updated on a frequent basis.

2.6.1.2 Flight Operations Software

Flight Operations Software (FOS) is Operationally Approved Software related to aircraft flight operations. FOS encompasses the majority of electronic documentation to support Flight Operations (cabin and cockpit manuals, charts, mission data, etc.).

This software may be managed separately from other ACLSPs and may be managed by an airline's Flight Operations Department as approved under operational approval. FOS should be managed via a process compliant with applicable regulations, such as:

- EASA AIR-OPS
- FAA AC 120-76A
- 14 CFR Part 121

2.6.1.3 Maintenance Operations Software

Maintenance Operations Software (MOS) is Operationally Approved Software related to maintenance operations. MOS is software that enables technical publications usage and technical publications. MOS should be managed via a process compliant with applicable regulations, such as:

- EASA Part M
- 14 CFR Part 121

COMMENTARY

MOS may be configuration managed separately from other ACLSPs.

2.7 Aircraft Support Data (ASD)

ASD is software or digital data for which use or modification:

1. Does not require Part 25 airworthiness approval, and
2. Does not require operator regulatory approval.

The operator has flexibility in defining which software fits this category versus Operationally Approved Software.

ARINC Report 675 discusses processes for managing ASD and certain Operationally Approved software. ARINC 667 does not discuss processes for ASD management.

2.8 Software Attributes

A given software or data item should be assigned attributes from both the software type categories and the software control and loadability categories in the operators' software management systems, for example:

- Cabin Temp OPS Software
  - ACS
  - Loadable
  - Part 25 Certified Software
- Flight Management NDB
  - ACS
  - Loadable
  - Operationally Approved Software
- IFE Settings UMS
  - ASD

This allows software to be sorted on any of the attributes or combinations of the attributes to determine various groups of software. For example:

- All ACS
- All HCS
- All Part 25 Certified ACLSPs
- All Operationally Approved ACLSPs

3.0 SOFTWARE DEVELOPED AND MODIFIED BY USERS

Software that is modifiable by the user (airline) is known as UMS and UCS.

3.1 General

ACLSP that can be developed or modified by the airline operator is User Modifiable Software (UMS).

The supplier of the software should provide specific documentation of the system operation, interactions with other systems, and expected or possible results of missing or incorrect UMS software. Airplane operators should evaluate this documentation and determine how UMS will affect their operations. It is ultimately the operator's responsibility to determine dispatchability.

In theory, UMS should not affect the technical dispatchability of an airplane.

Changes to UMS do not affect an aircraft system safety or any non-modifiable software. This basis permits such modification without certification authority review.

UMS may appear in many forms. It might be executable source code or contain software parameter settings for a particular system on a particular aircraft or databases. The user modifiable memory content does not affect the non-modifiable memory content. This is ensured by monitoring devices embedded in the core software that are inaccessible to the user.

UMS may be developed, modified, and reproduced by the airlines within the guidelines provided by the supplier under the terms of a Technical Service Agreement of either the target hardware and/or the software development tool. These guidelines may be in the form of User's Manuals, development documents, drawings, etc.

Software modification includes creation and modification of data, executable code, or both, and it also includes all associated documentation. UMS does not need to be reviewed by the certification authority, the airframe manufacturer, or the equipment supplier.

COMMENTARY

The TC/STC holder can define the software application(s) to accommodate airline customized data. The TC/STC holder may collate the airline customer's requirements and implement the customized software. The final product would be subject to type certification approval before release.

It is a common practice for the supplier of such type of software to develop a software customization tool for airline customers. The release of the tool may help to ease the certification approval activities, particularly for frequent changes.

The airlines can decide on whether to procure the tool and conduct their software customization in-house or to have the changes submitted to the Supplier for implementation and certification, whichever is deemed more cost effective.

UMS may contain pre-approved and validated components (i.e., lines of software) or a combination of components that may be activated by a user, either through selection by flight crew or activation by ground personnel. Again, it is expected that

this software can be activated by the user without certification authority review. These definitions provide guidance complementing RTCA DO-178()/EUROCAE ED-12().

Section 3.1.1 describes the procedure for development, modification, and handling of UMS.

3.1.1 Development and Modification Methods

Dedicated software generation tools are used to develop or modify files that may be subsequently loaded in the applicable aircraft systems. In some cases, these tools are defined and approved by the supplier. This is further described in RTCA DO-178().

Suppliers and/or aircraft manufacturers, under the terms of a Technical Service Agreement, should provide all necessary documentation to build and support the software development tool. These software development tools should provide the necessary functions for developing and issuing UMS such as: software editor, software compiler, software part number generator, and a media set creation tool.

An FAA Form 8130-3 or EASA Form One is not required for UMS. However, all software should have accompanying conformity documentation. Conformity documentation for UMS may be an Engineering Order (EO) for the software itself or a Certificate of Conformity (C of C) if a media set is generated. UMS that is created by an airline does not fall under the rules for the manufacture of parts by an operator. However, airlines should ensure processes that comply with internal airline business practices and procedures. Part of these procedures should include conformity documentation as described above.

COMMENTARY

FAA Part 14 CFR 21.303 was written for the manufacturing of physical aircraft parts. And as such this section does not apply to UMS. However, because of a lack of federal guidelines on UMS, some airlines can choose to follow 14 CFR 21.303 or be required by authorities to follow these guidelines.

3.1.1.1 User Modifiable Software from Designees

The process of developing/modifying UMS can be accomplished by an airline or by an airline designee. For the purpose of selecting a designee, the appropriate procedures and Quality Assurance requirements should be followed to evaluate and verify the UMS development capability of the designated party.

For software developed by designees, special conditions may apply. When an airline assigns a designee to provide UMS, the designee assumes all responsibility for the software part. For example, airlines may elect to provide design documentation to the designee, and the designee assumes all responsibility for the software part and for the confidentiality of the design data.

3.1.1.2 Operators Acting as Designees

Operators may elect to develop UMS and associated documentation for use by another operator. In this case, the developing operator is considered to be a UMS designee as described above in Section 3.1.1.1.

3.1.2 Configuration Management

UMS should have the same positive controls expected for the SCS. In the development of their configuration control program, airlines should define the business processes to accomplish the following:

- Define the internal requirements for the modification
- Determine if parts are to be ordered or built
- If the parts are to be developed and built internally:
  - Authorize and issue new part numbers
  - Enter change data into the airline change management system (see Section 8.0)
  - Create the new LSP and MSP [if needed] by means of software generation tools
  - Approve the master LSPs and MSPs for release and authorize for distribution
- If the parts are to be ordered:
  - Coordinate new part numbers with supplier
  - Enter change data into the airline change management system (see Section 8.0)
  - Receive and approve completed supplier LSPs and MSPs for release and authorized for distribution
- Establish engineering order classification
- Decision to provide UMS part to shops for preloading and airframe manufacturers for new aircraft provisioning

All remaining configuration management processes should be identical regardless of ACLSP type.

3.1.2.1 Authorization Documentation

In developing or modifying UMS, the airline assumes the responsibility as the designer and manufacturer of the resulting aircraft software parts. It is incumbent on the airline to develop procedures to ensure traceability of any parts to the original design documentation so that any problems that are identified may be investigated and resolved. The form of necessary documentation may vary between different operators depending on the national regulatory framework and internal organization of the operator. It is possible for the airline engineering design organization that develops or modifies the UMS to be the supplier of all software parts (LSPs and MSPs) destined for aircraft use or alternatively a separate production or copying facility may be utilized for distribution.

COMMENTARY

Many airlines have the capability to manufacture physical parts of many descriptions for use in the maintenance and modification of aircraft. There is a clear distinction between the role of the design organization that prepares design documents, such as drawings and EOs, and the workshop that produces physical parts. UMS is unusual in this respect. The design organization can design, create, modify and document UMS, which is itself an aircraft part.

3.1.3 Release of UMS

This section describes the design, development, storage, and distribution processes of UMS. UMS can be derived as an entirely new software or from development of a new software part from an existing part. The second case may evolve from an existing version of the software part in use or a baseline part supplied by a manufacturer. In both cases, documentation of the development process is necessary.

3.1.3.1 Design Process

Airlines advocate a common user-friendly process to create or modify UMS. The process starts with the acquisition of a new aircraft or system that makes the customization possible or with new requirements or problem resolution identified within the airline to alter an existing item of software. The engineer assigned to the task (referred to as the originating engineer) should coordinate with the appropriate users of the application (or resulting data) to determine the new requirements.

The originating engineer uses the appropriate software generation tool to create a new part in response to these requirements. Review of the software part development with the users is necessary to further refine the requirements, validate the solution, or explore new possibilities that have become apparent while creating the new software part. Testing is not required but is advisable for UMS. Testing is further described in Section 3.1.3.5.

3.1.3.2 Change Log

A change log should be maintained for the newly created or modified UMS. This should include details of the following for each new software version:

- Originating engineer
- Build date
- Software part number
- Any applicable filename reference
- Means of identifying the host computer
- Software generation tools
- Description of changes made
- Reasons for changes
- Aircraft applicability/effectivity
- Authority/Approval

The description of changes made may include references to other documentation, if appropriate, in which case a copy of the referenced documentation should be available.

COMMENTARY

While it may be necessary for a specification to be created for a completely new software part, it is often more convenient and effective to create the specification using the software generation tool itself to create an initial software part. This increases the chances that writing a specification is achievable. In many cases creation of a specification document would later require the same information to be

typed into the software generation tool. Similarly, the need to document a design specification may be met by retention of the source code which is viewable on the software generation tool, there is no imperative for such documentation to be on paper.

For software containing multiple components (e.g., modules, files) it may be more convenient to keep separate records for individual components and a separate high level document identifying:

- Components added
- Components deleted
- Components altered (i.e., replaced with a new version)

Ideally, this documentation would also identify version numbers for each component contained in a software release.

COMMENTARY

The term module is used to mean any independent component that is included in the resulting UMS part. There are cases where a software part comprises of many such components, and it is possible for the same components to be used in different UMS parts.

3.1.3.3 Identification

UMS should be considered as an ACLSP and should therefore be treated accordingly. ACLSPs require strict part number control, meaning that if a single digital bit changes in the software the part number should change.

The originator should ensure that a unique software part numbers identifies the UMS created. The software part number and transport media part number standards should comply with ARINC Report 665 wherever possible. ARINC Report 665 guarantees uniqueness of software part numbers throughout the industry through the use of a three-character company code embedded in the part number. It is recognized, however that some existing part number formats are in use, being constrained or defined either by the target aircraft system or by UMS generation tool.

In such cases, it is not reasonable to expect retrospective action to meet ARINC Report 665. The essential principle of identification is that a unique software part number should be used to define a single software version.

All developmental UMS that are used for aircraft tests should also be identified by a unique part number, and records of changes incorporated should be maintained as for production versions. It is conventional and good practice to adopt a part numbering format that clearly distinguishes versions intended purely for development tests from production versions.

3.1.3.4 Quality Assurance Process

A Statement of Conformity, Certificate of Conformity, or other validation documentation should be issued with the newly created UMS part, stating the compliance to pertinent methods of implementation and standards.

COMMENTARY

An FAA Form 8130-3 or EASA Form One is not required for UMS. However, all software should have accompanying conformity documentation. Conformity documentation for UMS may be an

Engineering Order (EO) for the software itself, or a Certificate of Conformity (CoC). An exception where a CoC would not appropriate when a media set is generated.

3.1.3.5 Testing

Before being released for operational use, UMS parts should be tested to an appropriate level. It is the responsibility of the airline to establish the test requirements and implementation means.

COMMENTARY

In many cases, the testing necessary is quite minimal, but in some cases exposure to the operational environment is advantageous. For UMS parts, testing is not required for any certification purposes, but it may be important to the operator to assess whether the change achieves the desired economic purpose.

3.1.3.6 Storage of Released UMS Parts

Released UMS parts should be stored according to the guidelines in Section 7.0, regardless of whether electronic distribution or physical transport media are used. The ground file server (vault) used to store the UMS parts may or may not be the same server (vault) used for received parts.

3.1.3.7 Physical Transport Media

Commercially available physical transport media (e.g., floppy disks, CDs, flash drives) may be used to transport the software when electronic distribution methods are unavailable. Depending on the types of media, there may be a requirement for physical storage media to be specifically approved for aircraft use.

All physical storage media used should be protected against inadvertent overwriting of the data. When physical transport media is used, all UMS should be produced and duplicated using stand-alone computers or secure computer systems to minimize the risk of the software being contaminated with viruses.

If a physical transport media set is created, for traceability purposes, records should be kept of the following items for each aircraft loadable media set manufactured:

- Software part number
- Media set part number or identifier
- Media set serial number
- Range and number of media set for copies made
- Date manufactured
- Recipient (or stores location) to which the copied media sets are forwarded (optional)

The guidelines of Section 5.5, Physical Media or Electronic Software Acquisition, apply.

3.1.3.8 Backups and Archives

A minimum of one copy of each UMS part should be retained. A minimum of two copies of the source code should be retained. In this context, source code refers to the computer files from which the host computer system generates the UMS.

One copy of each UMS part should be archived in an alternate location for additional protection from natural disaster. In cases where the contents of the UMS can be read by the host computer system and permit all functional aspects to be inspected, the UMS may be considered to be source code for these purposes.

3.1.3.9 Distribution

Distribution of UMS within an airline, airline designee or other aircraft operators could be by physical media or electronic crate. If the software is to be electronically distributed, the guidance found in ARINC Report 827 will apply.

3.1.4 Approval of User Modifiable Software

UMS can be modified by the aircraft operator without being reviewed by the type certification authority. The changes must be within the modification constraints established during the original certification. This is further defined in RTCA DO-178(). This software may or may not require operational approval through the airline's regulatory authority.

3.2 User Certified Software (UCS)

UCS defined by this document allows airlines to modify or develop software that requires type design approval and system type certification per FAA Part 25 by the appropriate airworthiness authority. UCS should be developed and controlled by the same processes outlined above for UMS, except as defined in the following sections.

UCS is an ACLSP that is defined by the aircraft manufacturers and systems suppliers as software subject to the TC/STC holder's approval, similar to an SCS, but yet it is user modifiable like a UMS.

It may happen that the TC/STC holder re-defines an ACLSP from being a UMS to a UCS because of certain concerns raised by the type certification authority, which would warrant a full TC/STC review for each evolution of the software.

An example of UCS is the Secondary Power Distribution Box (SPDB), a system on the A350 that controls the cabin circuit breakers. If the cabin electrical load is changed (i.e., galley changes, added seat functionality, etc.) the user will need to get the airworthiness certificate for this change

3.2.1 UCS Specific Processes

Airlines, airframe manufacturers, and software suppliers are expected to work together to ensure that UCS can be developed and approved in a cost-efficient manner.

In developing software intended as UCS, manufacturers and suppliers should recognize that airline engineering organizations might not be familiar with the detailed objectives of RTCA DO-178()/EUROCAE ED-12() and alternate means of compliance. Manufacturers and suppliers should provide guidance and support in establishing the necessary certification process, as needed.

COMMENTARY

Such support could take the form of failure modes and effects analyses, declarations of design and performance, system safety assessments, and other details needed for the specific UCS. These can identify the criticality of the equipment and the scope and limits

and effects of airline modifications, such that the extent of evidence required to be provided by the airline is clearly established.

The methods used to create or modify UCS are typically based on the use of dedicated software generation tools, used to create or modify files that may be subsequently loaded in the applicable aircraft systems. Although these tools could be defined and approved by the supplier, software modified by using these tools will require certification. This is further described in RTCA DO-178().

COMMENTARY

In the case of In-Flight Entertainment (IFE) systems, the IFE system does not affect any of the aircraft safety systems. In the case of Public Address (PA), the function PA ALL will continue to work even if the whole IFE system is down, including faulty modifications to UMS. But Zone PA could be affected, since it is controlled by the IFE CONFIG DataBase at each seat/zone level.

If the user (airline) modifies the UMS after it has been delivered by the supplier, the user may have to internally configure manage any changes done and distribute this with their own SB process.

3.2.2 Certification of UCS

UCS is defined as a software part that is certified to RTCA DO-178(), level D or above. As a consequence, additional objectives are necessary as defined in RTCA DO-178(). A change to UCS requires coordination and approval by the user's type certification authority. RTCA DO-178() is a means, but not the only means, to secure regulatory approval of software.

COMMENTARY

Many of the objectives of RTCA DO-178() may not be readily applicable to UCS regardless of the certification level. The airline may also wish to consider the fact that RTCA DO-178() is not a requirement in its own right but is recognized by most certification authorities as an acceptable means of compliance.

It is recommended that UCS be created using some form of graphical user interface or menu oriented high-level tool where the airline generally is not working directly with programming code. The tool may offer additional constraints viewed to be beneficial, including what areas and range of parameters that can be modified. Adequate documentation needs to be provided by the supplier on how to operate the tool correctly.

4.0 OVERVIEW OF ACS PROCESS

4.1 Process Overview

The overall role of ARINC Report 667 is to define the fundamental rules pertaining to ACS and guidelines for the configuration management of software at the aircraft level to ensure that the aircraft is maintained in conformance with its design documentation. A number of other equipment and protocol specifications play a part in achieving this end.

Specific details of individual activities that contribute to the overall management of ACS are provided in a selection of other documents. Figures 1-1, 1-2, and 1-3 provide an overview of the software loading concept and the role of each of the related documents. It is not intended to imply that all of the activities illustrated are essential in all cases or that all of the aspects covered are illustrated comprehensively.

The process for airline management of ACS involves the following contributing airline processes:

- Development and release of Airline Modifiable Software (AMS) (Section 3.0)
- Acquisition and receipt of spare ACS (Section 4.0)
- Distribution of ACS from OEM to operator, within operator facilities and from operator facilities to aircraft. (Section 5.0)
- Storage of spare parts in ground and onboard storage devices (Section 6.0)
- Receipt of a newly delivered aircraft by an airline (Section 7.0)
- Management of aircraft software configuration changes (Section 7.0)
- Software data loading (Section 8.0)
- Software part security during the processes of AMS release (Section 3.0), acquisition (Section 4.0), distribution (Section 5.0), and onboard storage (Section 6.0)

4.0 OVERVIEW OF ACS PROCESS

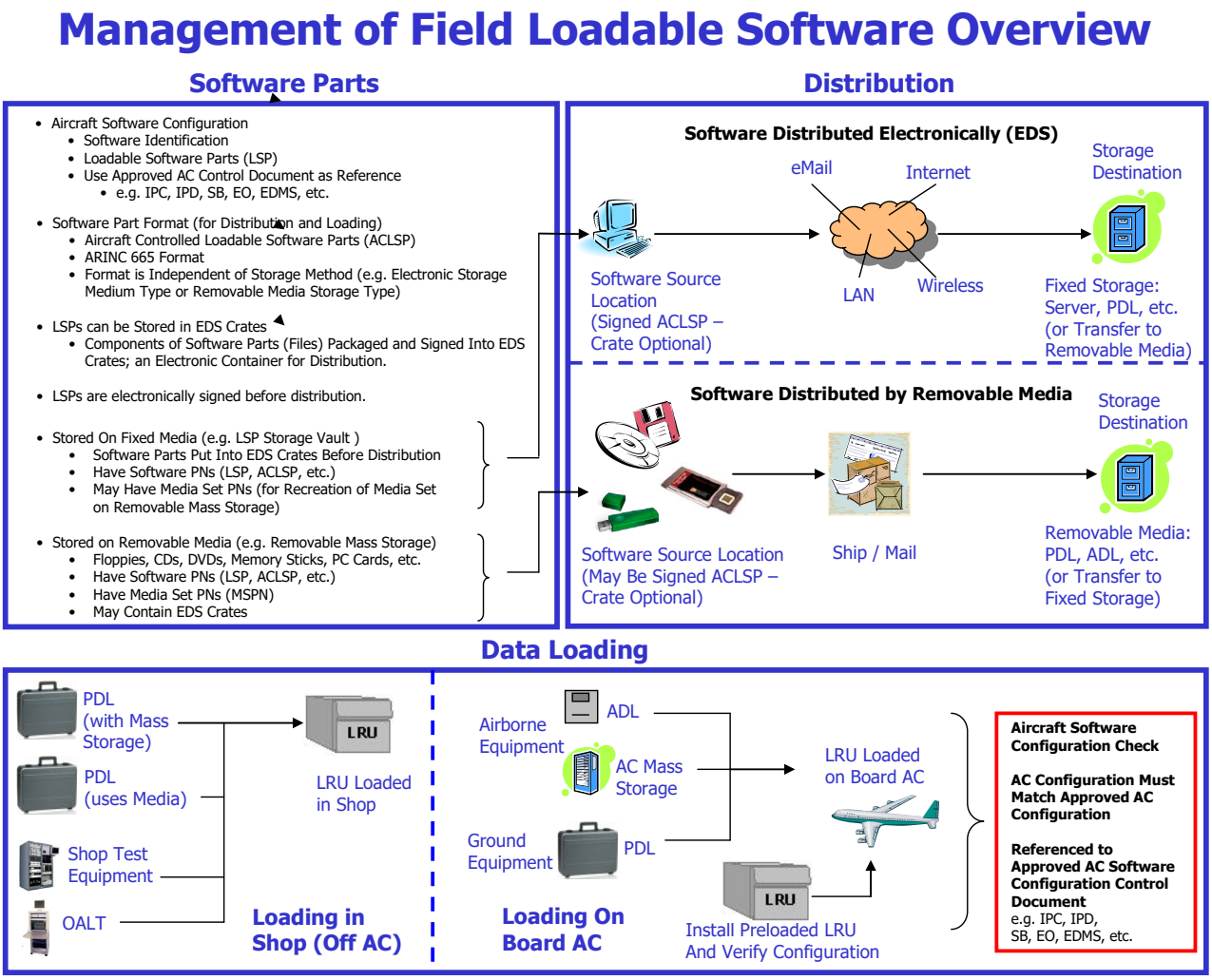


Figure 4-1 – Field Loadable Software Process Overview

The figure above shows a high-level overview of the interactions of aircraft software parts from creation to distribution and data loading.

4.0 OVERVIEW OF ACS PROCESS

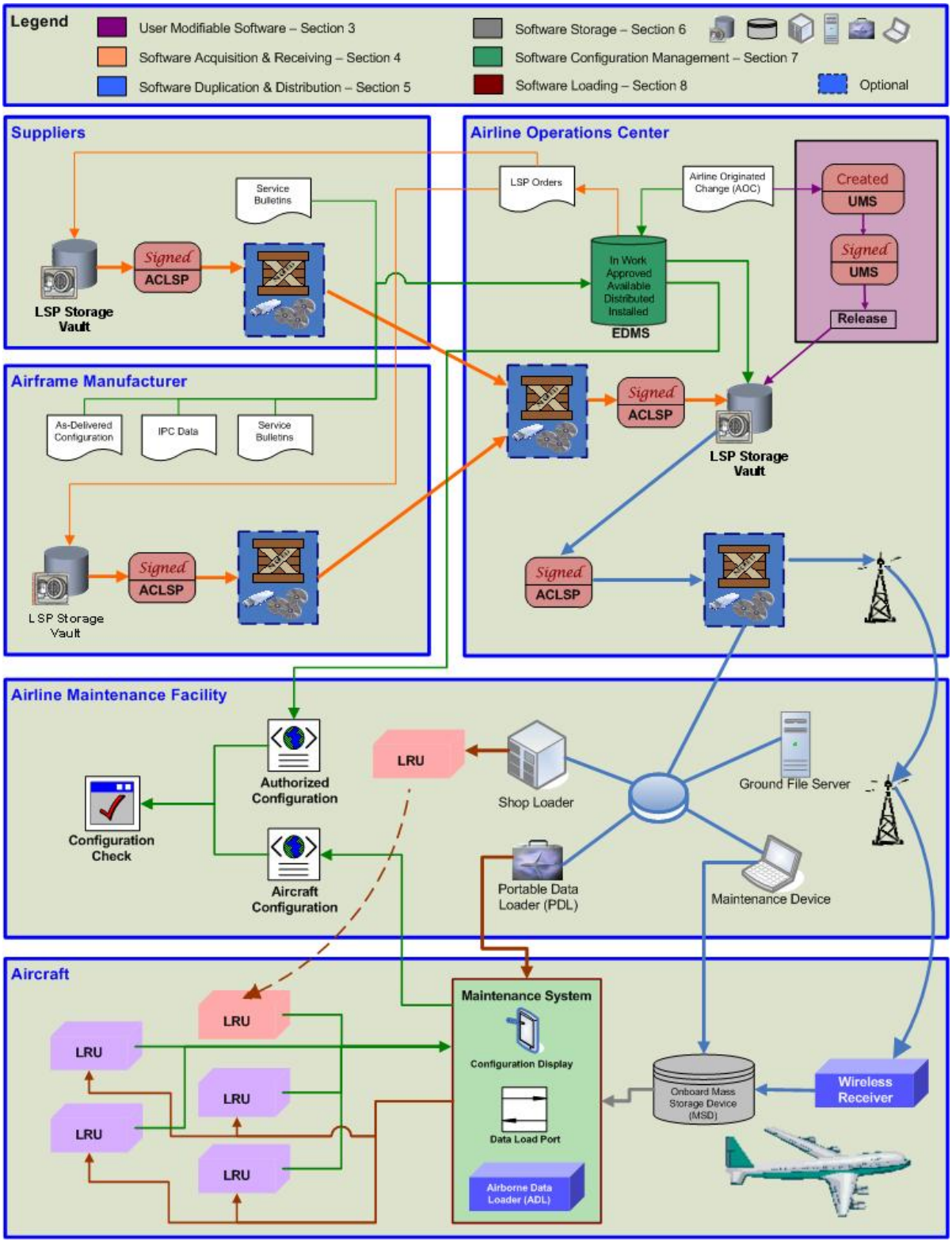


Figure 4-2 – Field Loadable Software Signed Electronic Distribution Process Overview

4.0 OVERVIEW OF ACS PROCESS

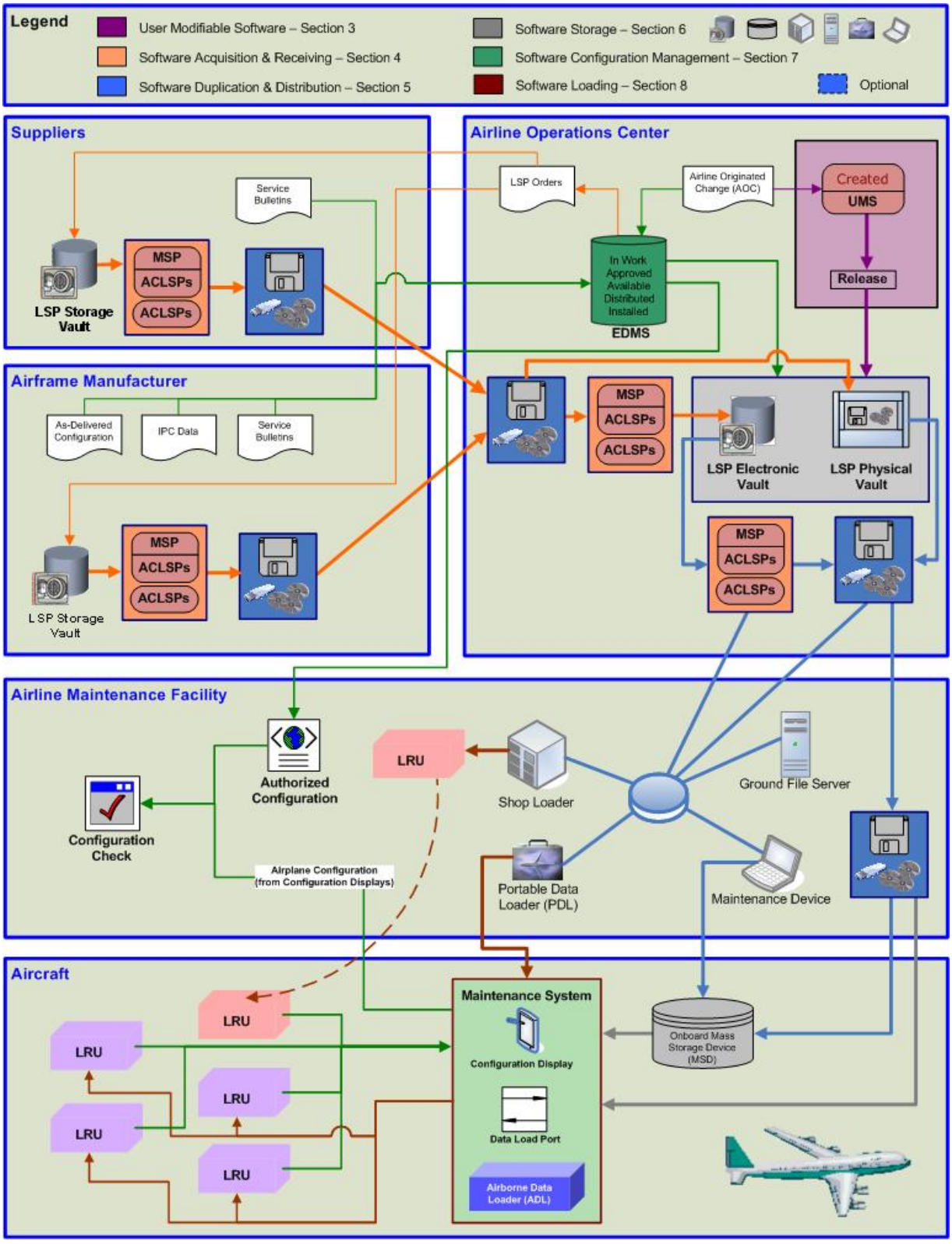


Figure 4-3 – Field Loadable Software Un-signed Distribution Process Overview

4.2 Overview of Field Loadable Software Management

Figures 4-1, 4-2, and 4-3 illustrate the entire process of FLS management. Figure 4-1 shows the high-level overview between the various sub-processes outlined in Section 1.8. Figure 4-2 describes the more current and preferred process utilizing signed electronic distribution. Figure 4-3 describes legacy processes utilizing physical distribution and unsigned electronic distribution from media. The subsections below provide an overview of software parts configuration management process, the signed electronic parts management process, and the physical parts management process.

4.2.1 Loadable Software Aircraft Parts Configuration Management

The goal of aircraft software configuration management is to ensure that aircraft are in correct software configuration at all times. Therefore, the first step in the management process is to prepare software parts to conform to a given aircraft's software configuration requirements. These requirements are determined by industry accepted authority control documents. These documents may be in the form of an IPC, Illustrated Parts Database (IPD), SB, EO, or other industry accepted format. These documents and data are recommended to be controlled and/or managed as applicable in an Electronic Data Management System (EDMS).

Software parts consist of electronic digital data that should be organized as per the ARINC Report 665 software part standard. This data may also be organized as an OEM specific software part format or legacy software part format.

The ACLSP configuration management process involves at minimum the following steps:

- Receiving an "as-certified" configuration from an airframe manufacturer and storing the data in the airline's EDMS.
- Receiving IPC/IPD Data from airframe manufacturers and SBs from airframe manufacturers and suppliers and importing this data into the airline's EDMS.
- Utilizing EDMS data to drive subsequent stages of the ACLSP management process, including ACLSP acquisition, receiving and releasing, ACLSP distribution, and installation.
- Optionally, performing aircraft-level ACLSP verification checks using an authorized configuration exported from an airline's EDMS and configuration data from an aircraft is recommended. Aircraft configuration data may be obtained from reports generated by the aircraft for aircraft that are so equipped or from aircraft configuration displays otherwise.

The ACLSP configuration management process is described in detail in Section 7.0.

4.2.2 Signed Parts Management Process

The signed electronic parts management process is initiated and works in coordination with the software parts configuration management process. The process includes software parts acquisition, receiving and release, airline parts creation and release, and software parts distribution and installation (loading). This process is the preferred process for managing FLS at airlines. However, it is understood that there are numerous situations where physical processes such as described in the next section need to be used.

4.0 OVERVIEW OF ACS PROCESS

The airline part creation processes include, at minimum, the following steps:

- When a need for a new airline created software part (i.e., UMS part) is identified, an Airline Generated Change (AGC) is created and entered into the airline's EDMS.
- The UMS part is then created based on this authorization.
- The UMS part is then signed and released into the airlines secure electronic LSP vault.
- The EDMS status for the part is then updated to indicate the part is available for distribution and installation.

Airline part creation processes are described in more detail in Section 3.0.

The software parts acquisition, receiving and release processes include, at minimum, the following steps:

- Upon determination that a new change is authorized in the EDMS, a check is performed to determine if the airline already possesses the part(s). If not, an order is initiated for the new LSP(s) and sent to the appropriate airframe manufacturer and/or supplier(s).
- The order is fulfilled from an authorized secure vault (or repository); the part(s) is/are digitally signed and sent to the airline. Parts may additionally be sent in a signed crate or copied onto physical media and sent to the airline.
- Airline will receive the part(s), extracting from electronic crate or physical media where necessary, inspect the part(s) and release the part(s) into their secure electronic LSP vault. The digital signature should be stored in the vault with its associated part.

Software parts acquisition, receiving and release processes are described in detail in Section 4.0. Software storage processes are described in detail in Section 6.0.

The software distribution process involves the following steps:

- In response to an approved change such as an EO or Work Order (WO), distribution of a software part(s) is initiated.
- Part(s) are replicated from the airline's secure electronic LSP vault with their digital signatures intact.
- Optionally, the part(s) may be packaged in a digitally signed electronic crate or on physical media.
- Parts may be distributed via wired or wireless technologies to a variety of software storage devices including the following:
  - Aircraft Onboard MSD
  - Ground File Server
  - Off-Aircraft Loading Tool, Shop Loader, or Test Equipment
  - Portable Data Loader (PDL)
  - Laptop Maintenance Device

Software distribution processes are described in more detail in Section 5.0.

The software installation process involves, at minimum, the following steps:

- Selection of correct software part for this intended target hardware, as prescribed by approved documentation
- Software data loading into target hardware (e.g., component)
- Verification of successful loading into the target hardware (i.e., load complete, no errors)
- Verification of the correct software part for this intended target hardware, as prescribed by approved documentation

Software installation processes are described in detail in Section 8.0.

4.2.3 Unsigned Parts Management Process

Although still used and necessary in many environments, unsigned parts are used especially where airplanes are in service that do not take advantage of signed electronic distribution methods.

Industry stakeholders are encouraged to use digital signatures on software parts, as well as use signatures on ARINC 827 EDS crates. The use of physical media should also be reduced.

The unsigned process is similar to the signed electronic process except as follows:

- Digital part signatures are not used.
- Distributions are sometimes performed using physical media.
  - In these cases, security is accomplished by a controlled physical environment.
- If unsigned parts are sent electronically,
  - Parts can be sent in a signed ARINC 827 EDS crate, or
  - Within a secure network (VPN), not in the public domain.
- An airline may employ an electronic LSP vault, a physical LSP vault (e.g., media stored in specially designed binders), or some combination of both.
  - An operator should employ processes to verify authentication and the security of the data when removed from the signed container.
  - Software parts should remain in signed containers until point of use.
- A replication process must exist to replicate physical media sets from either electronic and/or physical storage. Other physical handling processes may also be required.

Physical part management processes are discussed throughout the document but primarily in Sections 4.0, 5.0, and 6.0.

4.3 Procedures

There are some basic procedures for managing ACS and specific procedures for managing ACLSPs discussed in this document. Aircraft data loading facilities vary between aircraft types and systems. Specific aircraft loading procedures are defined in the Aircraft Maintenance Manual (AMM).

ACLSP may also be preloaded in the workshop in accordance with the airlines' in-house procedures or with procedures given in the Component Maintenance Manual (CMM) of the host hardware.

Should an ACLSP be preloaded in the workshop, the operators should be aware that the software configuration must be controlled at the aircraft and not at the component level.

Aircraft loading procedures may vary due to different type of uploading means. Software loading associated with conventional media such as floppy disks, CDs, DVDs, and USB MSDs require maintenance personnel to carry the media onboard and load via the designated device or interface port.

Software distribution via wireless transmission presents a very different approach as there is no physical media involved. The initialization of distribution could come from non-maintenance personnel. In this instance, procedures are provided to the ground administration personnel to distribute the software to another ground location or to aircraft file server. This procedure may or may not be part of the AMM. As part of the design of the aircraft, aircraft manufacturers should provide airlines guidance on what processes are to be employed for the distribution of the software from ground to aircraft.

For software that is carried on a physical media, the issue of the statement of conformity encompasses the manufacturing of the media and the software part (meeting design and certification requirements). The media is uniquely identified and serialized for traceability.

For software that is transmitted electronically or remotely, the statement of conformity only covers the software part and there is no unique copy or serial number.

In this case, new procedures need to be established to ensure traceability of ACLSP loaded on-aircraft; also, the procurement of the software from the suppliers.

4.3.1 Supply Chain

ACLSPs are loadable software, which are aircraft parts by virtue of their definition at design and should be controlled. However, ACLSPs have qualities that are unlike physical aircraft parts; ACLSPs can be used without being consumed, re-used on an indefinite number of aircraft, and duplicated or backed-up. To the closest possible extent ACLSPs should be handled as a physical aircraft part within its media or storage device. Deviation from standards of operation may give personnel another level of conflict with respect to handling and management of ACLSPs.

It is not the intent of this document to change essential internal airline procedures, but to recognize a need for industry guidelines and standards in this area. LSPs should follow a similar/like path of induction and stocking as non-ACS parts. Though the LSP is not an “on the shelf” item, it should have a physical storage location. Internal material system infrastructure should be evaluated and definitive procedures put in action to source, order, purchase, procure, receive, and stock these items. Past experiences have proven that a mirror image of the traditional aircraft part supply chain and the LSP supply chain is not a one-for-one swap. Material groups should work closely with engineering groups to develop the best possible methods and practices to reduce alternate procedures from standard procedures. Section 4.0 of this document should be reference for specific software acquisition and receiving instructions.

ACS that is not classified as an aircraft part may or may not be controlled by methods other than those required for aircraft parts. For example, Flight Operations Software (FOS) may be managed directly by the Flight Operations department.

While these are essentially internal airline issues, there is a need for recognized industry guidelines and standards in this area.

COMMENTARY

It was the original intention that the movements of ACLSPs need to be handled and managed using similar, if not exactly the same, processes as for other types of aircraft parts and materials, and in many respects, this is done. Some operators have, however, experienced difficulties, which have their roots in rights to copy issues and part numbering. In the latter case, problems can arise, for example, because the software and media set have different part numbers and because airframe manufacturers sometimes assign their own Media Set Part numbers which can differ from the supplier's assigned Media Set Part number. While there is a need to receive media sets into the maintenance organization as aircraft parts, there would be advantages in controlling them thereafter more like aircraft tools.

4.3.2 Maintenance Handling and Storage

Maintenance personnel need to know the location of ACS and how to obtain the correct data for the aircraft or component. ACS, in general, does not sit on a shelf and is not checked in and out. Documentation, such as engineering data, is typically used to manage ACS configurations. This data can be used by maintenance personnel to ensure the correct Part Number (P/N) and configuration for the software and aircraft/component to be loaded. Personnel charged with moving data from a non-aircraft or non-component location should be trained on what to do with ACS and how to handle the data.

Storage becomes reliant upon the persons designing internal procedures to develop storage that meets standards and operations of the users. The method of storage is also dependent upon the devices used to interface with components and aircraft. In this case, storage should not be confused with movement via media. Storage can be defined as a location for extended ACS life outside the aircraft, while the movement media can be defined as the device used to transport the ACS from Storage to the aircraft, component, or interfacing equipment. In some cases, these may be the same. ACS may be stored on a multitude of devices or systems, i.e., portable media or on MSD that may be part of a built-in loading facility. Section 4.0 of this document should be reference for specific software storage considerations.

4.3.3 Onboard Aircraft Loading

Aircraft loading procedures are defined in the AMM or other applicable documents. Data loading equipment vary between aircraft types, system operation and individual needs, typical examples include, but not limited to:

- Portable data loader connecting directly to the target hardware
- Loaders integrated into the target hardware itself that enable a portable transport media to be used directly
- Portable data loader connecting through a common data loading connector and selector switch
- Airborne data loaders installed in the aircraft

- Airborne loading function from another aircraft system such as a central maintenance system
- Cross loading of components from other components of the same type

Similarly, loading procedures vary but the following common features are necessary for configuration management of ACS:

- Electronic determination of currently installed ACS configuration on the hardware or aircraft
- Loading of ACS as necessary
- Confirmation of a successful ACS installation
- Confirmation that aircraft configuration is correct, following procedures specified by the operator

Data loading details are defined in ARINC Reports 615 and 615A.

4.3.4 Off-Aircraft Loading

In addition to ground support software and Hardware Controlled Loadable Software Parts (HCLSP), operators need to be able to load ACLSPs off-aircraft. Whenever possible, the target hardware should be designed to allow off-aircraft loading using a multipurpose Automatic Test Equipment (ATE) or a multipurpose Off-Aircraft Loading Tool (OALT).

Although an ATE can load software into target hardware, it is best used to perform return-to-service tests. An ATE should not be used primarily as a data loader. A dedicated OALT is more desirable by not blocking precious ATE resources.

Main reasons to preload are:

1. Optimizing the aircraft usage
2. Minimize the impact of onboard loading failures
3. Optimizing the aircraft maintenance resources

To support off-aircraft loading, the aircraft manufacturers and/or OEMs should facilitate and support multi purposed off-aircraft load tool. In addition, a software load process should be defined for each unit that is tested on multipurpose ATE or test bench.

The OEM of the target component should support shop load procedures and loader data so that aircraft operators can develop their own software load capabilities. Aircraft manufacturers and OEMs should ensure that CMMs provide these load procedures and step-by-step instructions for loading ACLSP into product at the shop.

Additionally, one standalone Data Loader for all loadable units is helpful to support and ease the maintenance process. This Data Loader can either be supported by the aircraft manufacturer and/or OEM.

Detailed guides for the content of a Technical Support and Data package related to ACLSP shop loading data are described in **ARINC Report 625:** *Industry Guide for Component Test Development and Management.* Shop data loader details are defined in ARINC Reports 615 and 615A, and ARINC Specification 826.

4.3.5 Off-Aircraft Loading of ACLSPs

ACLSP loading should not be part of a component return to service process.

However, if an operator prefers to preload the most prevalent software for a certain aircraft fleet, aircraft operators and certified repair facilities should simply note that the component contains software. The note should also direct the technician to verify the software configuration on the aircraft (see Section 8.6.2).

For more information about loading ACLSPs off-aircraft, refer to ARINC Report 849.

5.0 SOFTWARE ACQUISITION AND RECEIVING

5.1 General

There are several methods for acquiring LSPs. These include aircraft acquisition, target hardware acquisition, physical media procurement, and acquisition via Electronic Distribution of Software (EDS). These methods are discussed in this section.

EDS is a process whereby aircraft loadable software is moved securely from one entity to another entity or one site to another site without physical media. Examples are software transfer from airframe manufacturer or OEMs to airlines, MROs, training device manufacturers, and remote training centers.

5.2 Aircraft Acquisition

One method of acquiring loadable software is by delivery with an aircraft. Loadable software delivered with the aircraft using the following methods:

- Loaded in target hardware
- Physical media sets
- Loaded in on-board MSDs
- Electronic Distribution

5.3 Target Hardware Acquisition

ACLSPs may be pre-loaded into the target hardware when acquired by the operator (either as spare or replacement target hardware). Pre-loading does not ensure the software meets the correct configuration for a given aircraft.

Pre-loaded target hardware may have some means of temporary identification attached to indicate what ACLSP has been loaded. One method of identification is the use of tie-on-tags described in Section 4.3.5.

In all cases, the technician must verify the ACLSP part number after it is loaded on an airplane.

5.3.1 Authorization

Target hardware serviceability is documented by FAA Form 8130-3 or EASA Form One or Certificates of Conformity (COCs). The software pre-loaded into spare or repaired target hardware may be identified as part of the remarks section on the FAA Form 8130-3 and EASA Form One. This loaded software identification should be in addition to any tie-on-tags used to identify the software preloaded into spare or repaired target hardware. These remarks are for information only and do not authorize use of the noted software.

COMMENTARY

The Return To Service (RTS) status of target hardware is independent of the ACS software loaded. Proper system operation (and configuration) is a product of serviceable hardware and applicable ACS.

For airlines that wish to have the software pre-loaded, most certified repair stations require that instructions for pre-loading software be included on the repair order. For certified repair stations to perform software pre-loading, software suppliers or airlines must provide load procedures and load tool data.

COMMENTARY

It is common practice for airlines to place standing work orders that include routine software loading with maintenance facilities.

In some cases, target hardware may be ordered with preloaded software as part of a kit. These kits are not listed in the Airline Configuration Reference (ACR), Certified Configuration Authority (CCA), etc., and they cannot be ordered by a part number. This may create an invalid configuration. Airline configuration control strategies should provide reasonable solutions to this issue (see Section 7.2.1 for more information).

COMMENTARY

The use of a kit to identify the inclusion of software in the target hardware has caused much difficulty in the industry. Since the software is not included in the configuration of the target hardware as defined by the target hardware's part number, the loading of the software may create an unauthorized hardware-software configuration once installed. An operator's installation process needs to verify the correct software configuration.

In addition, the effectiveness and applicability of such kit part numbers is often difficult to establish. Since the part number of the kit that the OEM shipped (target hardware plus the ACLSP) does not match the part number of the target hardware that the airline ordered (with the courtesy load), it is sometimes difficult to process the kit through the airline's receiving inspection system.

5.4 Airline Rights and Entitlements

Airlines desire software for airplanes without copying restrictions rather than license per copy. The licenses should be based on airplane installation, not storage.

Airlines have identified some basic needs concerning ACS in general terms, and also ACLSP in specific terms. These rights and entitlements are discussed in the following sections.

5.4.1 Rights to Copy

When aircraft equipment is replaced for maintenance purposes, there is a need to ensure that the software configuration is in accordance with the certified configuration for that aircraft. To ensure that this is possible wherever the aircraft is at the time this action is necessary, copies of the relevant software need to be made available either at the various station or maintenance facilities or carried on the aircraft. The airlines therefore have an interest in being able to make backup copies of the software that they have legally obtained and to distribute it within their own organization for this purpose.

Concerns about the infringement of intellectual rights by copying of software, particularly in respect of the personal computer industry, has led to legal restrictions on the copying of software. This is intended to prevent exploitation of software houses, which would arise if one copy of a software item were purchased and multiple copies were made for the purpose of using the software on multiple computers. As a result, operators are faced with the task of obtaining specific rights to copy software. This can be a major administrative burden in producing backup copies for maintenance purposes within the airline industry.

The ACS supplier is expected to a make clear distinction of what constitutes airline rights to copy and what constitutes copyright protection.

5.4.2 Entitlements

When airlines and other aircraft operators purchase an aircraft, they are entitled to the initial set of loadable software. They should also be entitled to order up to a specific number of additional copies of original software. The number of copies and future updates should be determined by contractual agreements between the aircraft manufacturer, the software supplier, and the aircraft buyer. Airlines should be entitled to all software documentation fully defining computing application and associated software in sufficient detail to enable users to understand its normal operation.

For aircraft which depend heavily on EDS technology, besides the aircraft software configuration delivered in the aircraft MSD, aircraft operators should be entitled to have electronic access to software distribution sources to download Airborne Software and data required for aircraft functionality and operations. Aircraft operators should also be entitled to distribute this software within their enterprise to support aircraft maintenance operations. This should include simulators and MROs chosen by the airlines (particularly for the pre-loading of ACLSP).

SBs or Airworthiness Directives (AD) should provide the notification to the aircraft operator that there are software updates required to be downloaded. The industry standard that supports the EDS is documented in ARINC Report 827.

5.4.3 Authorization to Copy

Airlines should be permitted to make backup copies of legitimately obtained software as necessary to maintain aircraft functionality. Clearly, it would not be acceptable for an operator to buy just one copy of a software update, for example, and then install it across a fleet of aircraft, and such action would be in breach of contract relating to rights to copy software. However, it is desired to establish an industry understanding that, provided the guidelines contained in this document are followed, the duplication of software and onboard or off-board loading of this software is a necessary part of the standard operation of an airline or any other operator. Legal restrictions should not constrain legitimate airline use of backup copies of aircraft loadable software.

In the future, airlines expect that the purchase of a new aircraft will include explicit authorization to copy all software necessary to support the operation of that airplane. This includes distribution to ground locations (e.g., portable data loaders) and aircraft MSDs.

Prior to the delivery of the first airplane, airline operators require the authorization to copy ACLSP used with Seller Furnished Equipment and Seller Purchased Equipment. The airlines need to copy ACLSP in support of their operation. Therefore, airlines should be provided with reasonable procedures for copying ACLSP as defined in Section 6.0, Software Duplication.

ACS includes software used in the following classes of equipment:

- Seller Furnished Equipment
- Seller Purchased Equipment
- Buyer Furnished Equipment

5.4.3.1 Seller Furnished Equipment

Seller Furnished Equipment (SFE) is equipment that is purchased, installed, and certified on the aircraft by the airframe manufacturer.

The airlines desire authorization to copy ACS used with SFE at the time of delivery of the aircraft. This is usually accomplished by product support agreements signed between the suppliers/OEMs and airframe manufacturers.

COMMENTARY

Product support agreements can differ between various suppliers/OEMs and the airframe manufacturer.

5.4.3.2 Seller Purchased Equipment

Seller Purchased Equipment (SPE) is equipment that the airframe manufacturer purchases and installs at the direction of the airlines. At the time of delivery of SPE, the airlines need the authorization to copy ACLSP used with the SPE. This should be accomplished by product support agreements signed between the avionics/software supplier and the airframe manufacturer.

5.4.3.3 Buyer Furnished Equipment

Buyer Furnished Equipment (BFE) is equipment that the airlines purchase directly from the supplier. This is independent of aircraft manufacturer product support agreements. Therefore, airlines should obtain authorization to copy BFE software at the time of product purchase or contract.

5.4.4 Tie-on-Tags

The most common method of pre-load identification is a tie-on-tag. A tie-on-tag may be used to identify the software part numbers which an airline requested to be loaded into the target hardware. It should be noted that the tie-on-tag is purely for the convenience of the airline staff handling the target hardware.

The tie-on-tag is not an indication of airworthiness or serviceability of the target hardware, only identification.

All spare and repaired units loaded with specific software should have tie-on-tags. Target hardware which does not have a tie-on-tag provides no indication of what software is loaded. Some airlines use the absence of tie-on-tags as an indication that software is not loaded.

The information on a tie-on-tag should not be used for aircraft configuration. The airline maintenance technician must verify the part number of the installed software after the target hardware is installed.

The part number of a target hardware whose operation is determined or influenced by the software does not in any way indicate the loaded software part number. Methods such as tie-on-tags may be used to provide visibility of pre-loaded software in target hardware, but tie-on-tags are for convenience only and play no part in the assurance of continued airworthiness. The tags should be removed after installation of the target hardware.

5.5 Physical Media or Electronic Software Acquisition

Loadable software may be supplied in either one of two forms: (1) contained on physical media, or (2) in an electronic digitally signed crate. Electronic crates form a virtual shell around software and associated documentation. The crate also offers security to ensure that neither parts nor data are compromised in distribution. To provide additional security and integrity of parts, the software may also be digitally signed.

An airline should designate an organization for purchasing and ordering software parts. Generally, this organization is the airline's purchasing department. This organization should also be responsible for obtaining the appropriate documentation, including the appropriate licensing agreement for all intended installations. SBs or other suitable notification methods should be used to inform customers of software updates.

The process for acquisition of software through electronic means is defined in ARINC Report 827.

5.5.1 Software Documentation

Proper documentation should accompany the software received in either physical or electronic form. It is the desire of airlines that any software be accompanied by FAA Form 8130-3, EASA Form One, or COC.

Issuing the Form 8130-3, EASA Form One, or COC will enable the end users to determine airworthiness approval status of parts and appliances. Software part(s) received or retrieved with missing or inadequate documentation should not be made available for use on-aircraft or shop until complete/correct documentation is made available.

5.5.2 Documentation from Suppliers

Airlines normally procure software and associated documentation from the original software supplier. Appropriate conformity documents should be provided that allows traceability and accountability of the software/data. The intention of this documentation is to provide assurance that the part meets the approved design and is in a condition for safe operation.

Where third parties are responsible for design documentation of the software, they should deliver the appropriate conformity documents. The third party should also coordinate the need for Parts Manufacturing Approval (PMA) with their local regulatory agency, when applicable.

COMMENTARY

FAA Part 14 CFR 21.303 states, "No person may produce a modification or replacement part for sale for installation on a type certificated product except for parts produced by an owner or operator for maintaining or altering his own product." This regulation has been interpreted to mean that airlines expect suppliers to seek guidance from their local regulatory agency before providing ACLSP and HCLSP and the appropriate conformity documentation.

5.5.3 Authorized Sources

Only those sources identified by the TC holder, STC holder, the OEM, or the operator are considered to be authorized sources of loadable software.

5.6 Responsibilities for Receiving

It is very important that there are airline processes in place for the proper receipt of software from an OEM or supplier. The airline or training provider is responsible for the correct handling of software in accordance with supplier expectations, internal airline procedures, and regulatory authority requirements. The primary steps in the receiving process are receiving inspection, designation of a master image, software storage and quality management.

5.6.1 Receiving Inspection of Physical Media or Electronic Crate

Airlines should have procedures and processes to inspect software media or an electronic crate upon receiving it from both internal and external sources. At a minimum, the inspection should examine the labeling for media parts and crate metadata for electronic crates.

For media, the correlation between the documentation accompanying the media with the information shown on the media label should be confirmed.

For electronic crates, the correlation between the documentation and the electronic crate manifest (crate metadata) should be confirmed. Received media may have a quality stamp from the originator of the media that should be inspected.

For loadable software received in electronic crate, the receiving agent should perform the following steps:

- Validate the crate signature using ARINC Report 827 (if required).
- Store LSP as well as the associated documentation including part signature received with the LSP in the airline part storage system and/or airline document management system (file server).

In the case of an electronic crate, the part signature from the originator acts as the quality stamp which is validated when received.

Several ACLSPs for an aircraft may be stored on a single media device. In these cases, physical media may be received without part number control (in other words, not as an MSP). This media device could be managed by methods such as aircraft tail number and date applicability, a service bulletin number, or an EO reference number. In this case, it is not feasible that the list of ACLSPs held on the media is marked on the media label due to size constraints. These parts should instead be listed on a manifest shipped with the media.

Where the media is read-only, updates can be accomplished either by a complete re-issue or by issuing supplementary parts on additional media, either of the same type or of a lower capacity type, subject to the media drive types available on the aircraft. Note that there may be copyright issues with combining multiple suppliers' ACLSPs onto a single media part number. It is recommended that the ACLSPs be digitally secured using EDS when combined into a single media device.

ACLSPs on physical media should have part signatures and the receiving inspection processes should be similar to those for an electronic crate except that there may be no electronic crate signature to validate.

COMMENTARY

There are exceptions to this, though. For example, certain legacy airframes may not accommodate software containing part signatures and thus would not require inspection of the part or crate signatures.

The accompanying documentation for media or electronic crate delivered with the software from an external source should be in the form of FAA 8130-3, EASA Form One or COC. This documentation should be reviewed for completeness, and the software part number should be correlated to the software part number on the media label or electronic crate manifest. Software received with missing or inadequate documentation should not be made available for installation until complete and correct documentation is made available.

5.6.1.1 Designating a Master Image

When the software is delivered, the airline is responsible for designating a master image and storing it in their parts storage vault. This master image should be retained while that software part is a valid configuration for the airline operation. The serviceability information (FAA 8130-3 or EASA Form One) should also be retained. Airlines should develop a process that correlates the master image to the serviceability information. The serviceability information does not need to be kept with the master image or duplicate copies of the master image. The airlines' policies on keeping a master image may vary.

5.6.1.2 Software Storage Considerations

Airline storage of software media should meet the guidelines of Section 5.5, Media Packaging and Handling.

ACLSPs should also be stored in a centralized ground file server, hereto referred to as a parts storage vault. This is true regardless of whether the ACLSP was received in an electronic crate or on physical media. The server should have adequate protection against unauthorized access and should be protected from software virus. The ground file server should have adequate protection against power faults, heat, humidity, and other natural disasters.

If ACLSP stored in a parts storage vault is intended to be distributed electronically, part security should be implemented to ensure the integrity of the part from source to destination.

For ACLSP packaging guidance, reference **ARINC Specification 641:** *Logical Software Part Packaging for Transport.*

There are several spare ACLSP storage concepts available to airlines. These concepts are explained in detail in Section 5.4. Airlines may store MSPs aboard the aircraft in a designated container such as a physical media binder. ACLSPs may also be stored in a MSD or file server on the aircraft. Spare ACLSPs may also be stored in central locations under the Software Control Library concept. In selecting a storage concept, the information in Section 5.5, Media Packaging and Handling, should be considered.

5.6.1.3 Quality Management

Procedures developed for the acquisition and receiving of ACLSPs physically or electronically should be monitored by the airline quality program/process.

ACLSP procedures should be monitored by the airline quality program/process. Areas of concern are:

- Aircraft configuration control, ensuring that the correct ACLSP being loaded onto target hardware and that the mechanic is using the correct maintenance procedures for loading the ACLSP. These procedures should include the verification that the correct ACLSP was loaded into the target hardware after loading is completed.
- Ensuring the media set is marked and packaged as required by an operator's accepted process or the ACLSP has the correct part signature.
- Ensure that software images provided by EDS are properly identified and verified.
- Monitoring the media duplication process to ensure the correct ACLSP image is transferred to the media and labeled correctly.
- Monitoring the electronic duplication process to ensure the correct ACLSP is copied and delivered to airline destinations.

The airline's quality processes should address the areas of concern above, as well as contribute to an airline's configuration management program.

5.7 Certificate of Conformity

The Certificate of Conformity (CoC) is a document endorsed by a supplier representative indicating that the supplied good or service meets the specifications indicated on the CoC.

COMMENTARY

A CoC is not widely used as a document accompanying an instance of loadable software. Its naming is also often varied (e.g., Certificate of Conformity, Certificate of Compliance, Certificate of Conformance, COC, CofC, or C of C, etc.).

The CoC is currently used for the transfer of UMS and AMI types of airborne software as compliant receiving documentation.

The CoC may also be used as receiving documentation for any type of airborne software that does not require an FAA 8130 or an EASA Form 1.

The minimal set of information elements for a Software Certificate of Conformity (CoC) should include the following:

- A quality statement indicating that the supplier's accepted processes were followed in the creation and/or handling of the product, and that the product is genuine. Additionally, statements indicating the products compliance to pertinent methods of implementation and standards may be included in this part of the CoC.
- Supplier identification information (e.g., Company Name, Address, etc.)
- Customer identification information (e.g., Company Name, Address, etc.)
- The identification of the product(s) (e.g., Part Number, Version Number, etc.
- The supplier's representative approval signature

Figure 5-1 is a generalization of the minimum content needed to consider a CoC sufficient for an airline's maintenance processes.

Figure 5-1 – Example of a Certificate of Conformity

6.0 SOFTWARE DUPLICATION AND DISTRIBUTION

6.1 General

This section provides guidance on distribution and duplication of ACLSPs.

ACLSP distribution at any point may occur on either physical media or in an electronic form. Distribution of a particular ACLSP initially occurs from an aircraft manufacturer or supplier to an airline. The airline acquires and receives the ACLSP as described in Section 4.0. The airline then stores the software in a physical location or an LSP storage vault (as described in Section 5.0) using the Software Control Library (SCL) concept and processes as described in Section 6.4. Once the ACLSP is stored securely in an SCL, the ACLSP may be distributed to any number of airline maintenance locations or aircraft onboard locations.

6.2 Distribution Methods

ACLSPs may be provided using physical or electronic methods. This document recognizes the validity of each type of distribution method and provides appropriate guidance. However, it is the desire of the industry to limit the number of different delivery methods in order to simplify maintenance processes.

It is the responsibility of the supplier, at the time of distribution, to ensure that the ACLSPs meet the specification against which it is supplied. It is the users' responsibility to ensure that ACLSPs are properly replicated in any subsequent copies of that software.

Note that there is an important difference between the terms software distribution and software load. Different standards, protocols, and regulatory requirements apply to each process. The following paragraphs provide further information on each.

Software distribution is the process of transferring software parts between and within aerospace business partners or to an aircraft storage location. This includes software parts transferred on physical media or via electronic distribution. Software distribution to an airplane MSD does not affect the airworthiness of an aircraft because the MSD is not the hardware which operates the software.

Software load is the process of transferring software from a software loader to target hardware and into the program memory of the target hardware. This includes software loads which may occur onboard the airplane (onboard load) or off the aircraft (off-airplane load). The term data load is often used to refer to software load. Software loading generally does affect the airworthiness of an aircraft. The term software load should not be used to describe software distributions to an airplane MSD, because the MSD is not the hardware which operates the software.

6.2.1 Physical Media Distribution

Subject to the loading capability on the aircraft, software may be stored on several different types of media, including but not limited to the following media types: Floppy Disk, CD-ROM, DVD, PC Card, and flash memory devices. ARINC Report 665 specifies the media types viewed to be acceptable to the airlines but may not include some of the more recently introduced media types.

6.2.1.1 Floppy Disks

Floppy disk media is obsolete. Therefore, steps should be taken to replace floppy disk media distribution with more current technologies.

6.2.1.2 High-Density Software Media Sets

High density software media sets are media sets that have a higher capacity than floppy disks. These include CD-ROM, DVD, PC Card, and flash memory devices among others. It is more desirable for software to be stored and transferred using high-density media than on floppy disk as multiple software programs or databases may be stored on one medium. However, electronic distribution is more desirable than any physical media.

6.2.2 Electronic Distribution

Electronic distribution may be used to deliver software without physical media between any source and destination points. Distribution may occur using either wired or wireless technologies.

Examples include:

- Delivery from aircraft manufacturer or supplier to airline (acquisition and receiving aspects of this type of delivery are covered in Section 4.0)
- Internal transfer between two airline ground points
- Delivery to onboard MSD
- Delivery to an Airborne Data Loader (ADL), a PDL, or OALT systems

ARINC Report 827 defines an industry standard method for Electronic Distribution of Software (EDS).

6.3 Aircraft Controlled Software Distribution

In general, the procedures established for ACLSPs should be applied for all types of ACS.

ACS distribution may vary between organizations. This document recognizes both the need for internal distributions within organizations and the need for external distributions between organizations.

Physical distribution can include duplication of ACS onto physical media, labeling of media, and delivery to airline shop or line maintenance locations.

Electronic distribution should be performed using electronic crates as defined in ARINC Report 827, which defines crates as primarily a short-term point-to-point secure transport mechanism using digital certificates.

Securing ACLSPs may be accomplished by any of the following methods:

- Signed electronic crates
- Signed software parts
- Secure transport protocol (VPN, SSL, etc.)
- Physical media and/or data loader control
- Any combination of the above

COMMENTARY

Using a secure transport protocol (e.g., SSL, VPN, etc.) without securing the ACLSP or crate may be acceptable in some cases, if allowed by the applicable regulatory authorities. However, securing the crate and/or the ACLSP is considered superior to only relying on a

secure transport protocol. These methods can be used in combination to provide increased security.

Potential physical software storage destinations for ACS distributed electronically are described in Section 5.0.

6.4 Software Control Library Concept

An SCL, or equivalent, can be developed as a physical and/or an electronic location in which all master software parts are stored and controlled. When an electronic location is used, it is referred to as an LSP storage vault, which is described in Section 6.0. The SCL can be used to maintain physical configuration control of software. The SCL can create copies of (duplicate) software for electronic distribution or physical media distribution. The SCL should meet all the requirements contained in Sections 5.4 and 5.5 to ensure integrity and configuration control during the software duplication and distribution process.

While the SCL can maintain physical configuration control of software through the receiving, duplication, and distribution process, the SCL is not responsible for aircraft configuration management. This can be handled via the configuration management processes described in Section 8.0.

Software stored in the SCL and designated for training purposes, such as software that will be loaded on a training device, should never be mixed with software designated for an aircraft.

6.5 Media Packaging and Handling

A Media Set Part (MSP) number should be assigned, and it should be different from the LSP numbers contained on the media. Where LSPs are too large for a single media device, multiple media members are used, and the group of media members is referred to as a media set. The MSP number should cover all media members. It is also possible for a media set to hold more than one LSP where a group of LSPs for a particular system may be packaged together. As these MSPs hold LSPs, it is essential that the appropriate quality control procedures, identification, and tracking are applied to the MSPs.

Certain LSPs can be common to a number of different target hardware on the same and/or different aircraft. A given set of LSPs may be contained on different media types as needed where different aircraft loading equipment is in use. In such cases, it is necessary for a different MSP number to be assigned for each media type. For all of these reasons, it cannot be assumed that there is a one to one relationship between LSP numbers and MSP numbers.

When LSPs are distributed on media for short periods of time and software loading equipment can accept the LSPs electronically, it may not be necessary to apply a permanent Media Set Part number to the media. In this case, the media is simply a transport mechanism to be used when electronic networks are down. At any rate, the LSPs should be digitally secured using EDS methods, the same as if the parts were being distributed electronically. A temporary identifier (e.g., order number) may be attached to the media in this case to help the receiver process the media and retrieve the LSPs contained on it.

6.5.1 Labeling

The supplier of any media delivered to the airlines is responsible for labeling the media. The media for internal airline use should be clearly labeled with sufficient information to identify the media content.

Note that if software is distributed electronically and needs to be copied onto media for airplane or shop loading, label information should be transmitted electronically with the software parts.

Recommended media label content and format is specified in ARINC Report 665.

COMMENTARY

Some airlines prefer the label be as simple as possible to reduce the chance of error when identifying software for updating. For example, if the Media Set Part number is shown in addition to the software part number, it can lead to confusion over which part number needs to match the service bulletin instructions.

6.5.2 Storage and Handling

Media handling practices should be developed based on recommendations from manufacturers of the media.

Consideration should be given to avoid physical damage to the media due to factors such as temperature, humidity, vibration, electromagnetic radiation, dust, chemical and airborne contamination, moisture, and abusive handling.

6.5.3 Transportation of Media

Magnetic media that is transported from one location to another should be wrapped or bagged in a dust free, lint free, electrostatic discharge protected material. Media shipped to off-site locations should additionally be packaged in a closed box or envelope. All media should be clearly and properly labeled for transport. Any media packaging should be clearly labeled as containing magnetic media, if applicable. See figure below for an example of magnetic media shipping label.

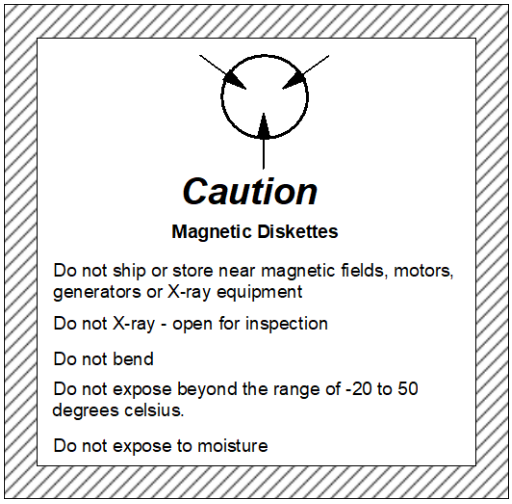


Figure 6-1 – An Example of a Floppy Disk Label

6.6 ACS Duplication

6.6.1 Supplier Intellectual Property

Airlines expect to be authorized to use and copy the ACS parts that are required to maintain the authorized configuration of their aircraft. Therefore, the owner of the software intellectual property rights is expected to grant the right to an airline to copy software that the airline is authorized to use, provided the airline respects the following needs of the supplier:

- Protect the intellectual property rights contained in the software
- The software will be used by the airline only in applications that are authorized by the software supplier

6.6.1.1 Airline Responsibilities

Airlines and their designees should hold, use, and copy software in conformance with the guidelines of this document and are expected to provide adequate assurances to the intellectual property owner that the software is not used or copied for purposes other than those permitted. The airline should maintain a list of LSPs for which permission to duplicate is authorized.

Airlines should maintain a process in which copied and distributed software is traceable to the original airline source (i.e., master copy) from which copies were made. The original airline source could be a file transferred electronically or a physical media obtained from a software supplier or aircraft manufacturer.

The airline's rights to duplicate may be transferred from the airline or training device manufacturer to a maintenance provider (MRO).

6.6.1.2 Airframe Manufacturer Responsibilities

To assist the operators with software configuration management, airframe manufacturers should obtain rights to copy software from the LSP suppliers for all SFE and SPE software delivered on an aircraft.

When the airframe manufacturer issues a SB for approved use of a new software part, the airline should be granted the rights to copy the new software.

6.6.1.3 Responsibilities of Other Parties

An airline, training device manufacturer, or airframe manufacturer may duplicate software for distribution to a remote location. A third party may distribute software as defined by the license agreement when the Supplier has granted Rights to Copy.

6.6.1.4 Designee Responsibilities

Any maintenance provider acting as a contractor of an airline should protect the integrity and security of the intellectual property; this should be addressed in a contract or negotiated with the supplier.

6.6.2 Copyright

It is the practice of most suppliers to copyright their software. Applicable copyright regulations should be adhered to in any duplication procedures instituted by an airline.

The ACS supplier is expected to a make clear distinction of what constitutes airline rights to copy and what constitutes copyright protection.

6.6.3 Duplication Process and Tools

The airline is responsible for using a software copying process and tools that will not alter the software image. The copy process should provide a means to ensure that the copies created are identical to the software being copied. Failure to make an exact copy could result in the LSP failing to load. Airlines desire a standardized process for duplicating LSPs, minimizing the use of different duplication processes from multiple LSP suppliers.

Integrity checks and bit image comparisons should be used to ensure that the software image has not been altered during the duplication process. Some examples of integrity check are:

- CRC – Cyclic Redundancy Check
- MDS – Message Digest Algorithms
- SHA – Secure Hash Algorithms

6.6.4 Quality Assurance Program

The software quality assurance procedures should be defined and described in an accepted quality management system.

6.6.5 Integrity

To ensure the integrity of all copies of software parts, the CRC or other integrity check methods should be used in compliance with ARINC Report 665.

The software (MSP or LSP) is processed with the appropriate integrity algorithm to yield a check value. When the software is copied, the copy integrity check value is compared with the master software part check value. If the two check values do not agree, then an error has been made in the copy operation, and the software part is unserviceable.

The integrity check value used for software loading is independent of the integrity check used to duplicate software. Various software tools are available to calculate various forms of integrity checks.

Even if the software part does not conform to ARINC Report 665, a CRC or other integrity check value can be generated for any file using various software tools. The software part supplier should provide the integrity check value (and the method used to calculate the value) upon request.

6.6.6 Virus Considerations

The ground systems used for software distribution, duplication, and storage should be protected against malicious data such as viruses.

Most aircraft systems are protected against viruses during normal operation by unique file formatting, including the integrity check, which prevents software loading if data has been altered. Furthermore, the unique architecture of airborne systems generally prevents virus execution. More information on integrity checks can be found in Section 5.6.1.

6.0 SOFTWARE DUPLICATION AND DISTRIBUTION

COMMENTARY

Training devices may allow data loading using different methods than the data loading methods used on actual aircraft. As a result, some virus protection strategies that may exist in the aircraft data loading process might not be available on the training device.

7.0 SOFTWARE STORAGE

7.1 General

Software parts have attributes that make them different from hardware parts. Appropriate storage facilities, planning, and support infrastructure, compatible with each operator's operations are required for software parts.

ACLSPs may be stored on many types of media and stored on many different devices at many locations depending on business needs. This section outlines the most important of these storage locations with respect to the airline's business processes.

Aircraft delivered with loadable hardware may include a spare set of ACLSPs stored on media or on-aircraft MSDs. The media may be contained in designated storage location on-aircraft or off-aircraft. ACLSPs that are stored on physical media or MSDs should be considered spare parts that do not affect airworthiness. The ACLSP becomes part of the aircraft installed configuration when it has been successfully loaded into the target hardware.

7.2 On-Aircraft Storage

In general, the ACLSPs stored onboard an aircraft should be maintained current for that aircraft configuration, including any alternate configurations. Obsolete or superseded ACLSPs should be removed from the aircraft to avoid configuration management issues.

There are instances where it may be advantageous to store future or superseded ACLSPs as well as the current ACLSPs on the aircraft. For example, during an ACLSP configuration change, the airline may store both the future ACLSPs and the current ACLSPs, until the modification can be scheduled for installation.

If an Airworthiness Directive or a safety related issue directs removal of obsolete or superseded software, then ACLSPs should be removed from all on-aircraft storage locations.

7.2.1 Onboard Mass Storage Device

Onboard MSDs with file server capabilities are often used to store ACLSPs. Onboard software load functions may load software from an MSD. To maximize the effectiveness of MSDs, it is recommended that the ACLSPs configured to each aircraft be loaded on the MSD. Obsolete or superseded ACLSPs should be removed.

Onboard MSDs should contain a full set of ACLSPs required by any possible configuration for that aircraft, including software for all interchangeable and intermixable configurations. Airlines may choose to hold a superset of all current ACLSPs on replacement MSDs to have a single MSD configuration across multiple aircraft.

Aircraft configuration management is maintained by ensuring that the correct ACLSPs are installed in the correct target hardware locations on the aircraft according to the operator's configuration control documentation. However, business and regulatory concerns may drive the need for similar configuration control methods for configuring onboard MSDs. For example, an AD could require software to be replaced or removed for safety of flight reasons. See Section 6.0 for more details.

7.3 Off-Aircraft Storage

All software distributed electronically or on media should originate from one or more secure off-aircraft storage locations. A process must be developed to identify how maintenance personnel can obtain parts for onboard loading from the storage locations.

Off-aircraft software storage can apply to ACLSPs and HCLSPs (used for hardware modification). The general term LSP is used where processes may apply to either type of software.

If an Airworthiness Directive or a safety related issue directs removal of obsolete or superseded software, then ACLSPs and HCLSPs affected should be removed from all off-aircraft storage locations. One must also ensure that stock and spare target hardware be sanitized if preloaded with software affected by the Airworthiness Directive.

7.3.1 Ground-Based File Server

A ground-based file server may be used as a media backup or as a means to store and distribute LSPs electronically within an airline for installation on an aircraft or in a component shop. Multiple ground-based file servers may be utilized to support ground operations.

To maximize the effectiveness of a ground-based file server, the LSPs applicable to an airline's fleet of aircraft should be available on the file server. The file server may be included in the operator's released configuration control process.

The airline or maintenance provider should ensure the security of file servers. The access to the server should be limited to those requiring access for operational reasons. When transferring software (i.e., from a ground-based file server to another location), a change log should be maintained as a part of the file server management process to assist with distribution troubleshooting or security events. The file management process should also provide a means for tracking the EDS from the server to an onboard MSD.

7.3.2 LSP Storage Vault

An LSP storage vault is a type of ground-based file server used to store LSPs electronically in a permanent central repository. An LSP storage vault is used by an airline SCL to perform physical configuration management and control of LSPs. SCL processes are generally used to manage this storage (see Section 5.5). Most LSP duplication and distribution activities performed by airlines should occur from master images stored in the LSP storage vault. Airlines may implement multiple instances of an LSP storage vault from which to perform duplication and distribution activities. Processes are needed to verify the integrity of stored LSPs and to reconcile the contents of multiple vaults.

LSP storage vaults should have the capability to prevent access to LSPs that have been removed from aircraft via an Airworthiness Directive.

Aircraft manufacturers, suppliers, and training providers may also have SCLs and associated LSP storage vaults. However, those processes are outside of the scope of this document.

COMMENTARY

Electronic distribution from aircraft manufacturers and suppliers to airlines is assumed to occur from a secure storage location.

7.3.3 Shop Loader MSD

Shop loaders are used by operators to preload target hardware off the aircraft. Many shop loaders have MSDs. Shop loaders are considered to be maintenance support equipment.

To maximize the effectiveness of shop loaders with MSDs, the software applicable to each target hardware to be pre-loaded should be available on the shop loader MSD.

7.3.4 Portable Loader MSDs

Portable loaders are used for loading software into target hardware both off-aircraft and on-aircraft. Many portable data loaders have MSDs. Portable loaders are considered to be maintenance support equipment.

To maximize the effectiveness of portable loaders with MSDs, the LSP applicable to each hardware target loadable by the portable loader should be available on the MSD.

7.3.5 Media Storage

LSPs are often stored on physical media (e.g., floppy disk, CD-ROM). Physical media (MSPs) may be part numbered to assist configuration control of the media. Physical media may contain multiple LSPs. Operators using MSPs must manage the correlation of LSP numbers to the associated MSP numbers. Operators should have processes to ensure media is stored and handled properly for each media type.

7.4 Binder/Storage Box

Aircraft manufacturers may deliver new aircraft with media storage containers (e.g., binder, storage box) for storing LSP media. The aircraft operator may choose to store the physical media on the aircraft or to remove the media from the aircraft.

Some airplanes types may require the entire suite of software to remain on the aircraft as part of the Type Certificate. Airlines should research and adhere to their governing regulatory requirements.

Media storage containers are considered maintenance support equipment. The operator should develop processes for the management of the storage containers stored either on or off the aircraft.

To maximize the effectiveness of media storage containers, the LSPs applicable to each aircraft that will be loaded from physical media should be available in these media storage containers.

7.5 Process Controls

Recommendations for periodic penetration testing of the networks?

The network used to distribute software shall log network transactions.

LRUs should not be considered serviceable if they have not been loaded with software via a secure process involving a hardened software loader that does a tamper check.

Software which fails a tamper check shall be quarantined and the incident shall be reported to TBD.

PDL or ground server logs should be retained for at least 90 days.

Consider recommendation to store longer for litigation purposes.

7.5.1 PDL Device Management Controls

Table 7-1 provides guidance for airborne software stakeholders. Users should implement one of the levels of acceptable confidentiality controls for software stored on PDLs.

Table 7-1 – Device Management Controls

Electronic Access Control	Physical Access Control	File Encryption	Acceptable Yes/No
High	Strong	On	Yes
High	Strong	Off	Yes
High	Conventional	Off	Yes
Medium	Strong	Off	Yes
Medium	Conventional	On	Yes
Low	Strong	On	Yes

Note: If we accept low EAC we should at least have a limited timeframe.
All other combinations are not acceptable.

Operators must have processes to monitor and patch CVEs applicable to PDLs.

7.5.2 Media Management Controls

Implement recommended access control guidance per section 2.6.4 (media physical access control) for media containing airplane software (e.g., CDs, DVDs, etc.).

Generally, read-only media should be used for LSP storage and distribution. Read/write media such as USB storage devices risk infecting devices they interface with (e.g., unauthorized access, malware, etc.).

Guidance about to secure USB media (e.g. iron key) – solutions should be technical rather than process. Should we allow the use of USB media for software?

7.5.3 PDL and Media Physical Access Control Levels

Table 7-2 has examples of Recommended and Conventional physical access controls for multi-user mobile devices (e.g. PDLs, PMDs) containing software. Operators should set up policies and procedures covering the control areas described as a minimum.

Table 7-2 – Control Access according to Controlled Area

Control Area	Strong	Conventional

Devices are stored in a secure location with physical access control	Specialized storage areas with badged access control	Storage cabinet with keys Controlled areas for employees only
Device issuance time should be limited	Limited to time required to complete an authorized maintenance, operational task or action.	For blocks of time
Governed by the operator's processes and procedures.	Processes and procedures are audited frequently for compliance	Processes and procedures are audited by exception
Security training	Users required to take security training before being authorized	No specific security training
Device issuance should be controlled (e.g., authorized users only)	Limited to users with specific job roles/functions (trained to use the PDL).	Broad issuance to groups
Issuance reason	Specialized devices and with clear purpose for issuance	Multi-function devices and/or reasons for issuance not tracked
Check in/check out	To individuals with procedure to track returns to the secure location of storage	To a group
Inventory of devices	Daily, automated inventory	Periodic or by exception
OS level account logging	Enabled and audited	Not enabled or not audited
Process for lost and compromised devices - Treated as a Security Incident with a documented Incident response processes.	Specialized team to handle such incident responses	Handled by user/user group

7.5.4 Media Physical Access Control Levels

Table 7-3 has recommended physical access controls for physical media containing software. Operators should institute policies and procedures covering the control areas recommended as a minimum.

Table 7-3 – Physical Access Control Recommendations

Control Area	Recommendation
Media stored in a secure location	Specialized storage areas with specialized access controls
Media issuance time should be limited	Limited to a maintenance shift

Media issuance should be controlled	Limited to users with specific job roles/functions with procedure to track returns to the secure location of storage
Inventory of media	Quarterly or better
Governed by the operator's processes and procedures. (e.g., processes to ensure malware free media, lost or damaged media)	Processes and procedures are audited frequently for compliance and actions taken to correct identified issues
Read-only media	Media such as DVDs and CDs, Boeing format-specific floppy disks
USB Memory Devices	Procured from a reputable vendor using secure supply chain Either restricted write access USBs, or encrypted password protected USBs

7.5.5 RTCA DO-355 Traceability

The most prevalent security document concerning software security is RTCA DO-355 (and its European equivalent EUROCAE ED-XXX). Table 7-4 provides an equivalency map to use ARINC Report 645 guidance for security.

Table 7-4 – Traceability Map between ARINC 645 and RTCA DO-355

ARINC Report 645 Reference Section	Specific Topic	RTCA DO-355 Reference Section
Section 2.1	Verify I&A of software before loading	Section 2.2.7
Section 2.1.1	Digital certificate management	Section 7.1 Section 7.2
Section 2.2	GSE electronic access controls	Section 5.2.2
Section 2.3	GSE network access	Section 5.2.3
Section 2.4	GSE device hardening	Section 5.2.1
Section 2.6.1	GSE usage and storage	Section 5.2.3
Section 2.6.2	Media controls	Section 2.2.4

7.5.6 Data Retrieval Security

TEXT NEEDED

8.0 AIRCRAFT CONFIGURATION MANAGEMENT OF ACS

8.1 General

The airline is responsible for the total configuration management of the aircraft as it is utilized within the airline's business. This responsibility includes ACS which is part of the type certified configuration of the aircraft as well as ACS that is not part of the aircraft type certified configuration. Airlines have a choice to manage all ACS in the same manner or establish different processes for both types of ACS.

Following are the fundamental elements of ACS configuration management:

- Establishing an authorized software configuration for each aircraft that follows the allowable certified configuration options
- Establishing processes to ensure that all aircraft conform to the authorized software configuration following any maintenance activity that may affect the software configuration.

Efficient processes for ACS configuration management are vital to an airline's business. ACS configuration management processes can impact other maintenance processes, including inventory control, purchasing, supply chain logistics, maintenance planning and execution. Newer, more complex aircraft with higher quantities of ACS will likely require different configuration management processes than older aircraft did. It is expected that existing configuration management processes for legacy aircraft will evolve to the new process described here over time. For description of the previously defined configuration management process, refer to the original release of ARINC Report 667.

Flight training device manufacturers, users, and operators should employ this guidance as applicable when installing ACS in simulation devices. More guidance on flight training device simulator software can be found in ARINC Report 610.

8.1.1 Configuration Management Vocabulary

The following definitions and figures are provided for proper understanding of the content that follows. The figures show the relationships between hardware and software

Interchangeability: The ability of an item (e.g., SW part, HW part) to replace another one without alteration and fulfill the same requirement. The form, fit, and function remains exactly the same when an alternate choice of hardware or software is made.

Compatibility: The ability of software to properly function in a target hardware environment.

Mixability: Mixability refers to compatibility of the hardware and software between two or more different hardware units or systems.

S1000D: An industry standard for the data format of Technical Publications expressed in XML format. Examples are: AMM, IPD, and SB. IPD is the electronic form of what is currently referred to as an IPC.

Certified Configuration Authority (CCA): The FAA/EASA Part 25 authority data issued by the TC or STC Holder that defines all allowable certified hardware and software modification options that are applicable to each aircraft system.

Airline Configuration Reference (ACR): The in-service configuration management system for the airline's fleet. This reference should capture the required configuration for each aircraft in the fleet and each ACLSP with associated hardware that is authorized to be installed regardless of regulatory requirements.

Functional Item Number (FIN): A FIN identifies an item performing a function within a system. A FIN is unique for the whole Aircraft.

Software Location ID (SLID): Software Location Identifiers identify where software is installed in the aircraft for purposes of confirming that the aircraft is in the proper configuration.

Airline Generated Change (AGC): Any change from system suppliers or airlines that have no accompanying SB. An example is an airline created UMS change.

8.1.2 Configuration Accountability

It is important to establish the accountability for the software configuration of an aircraft from time of delivery of that aircraft to an airline customer through its entire life cycle. This section clarifies those accountabilities.

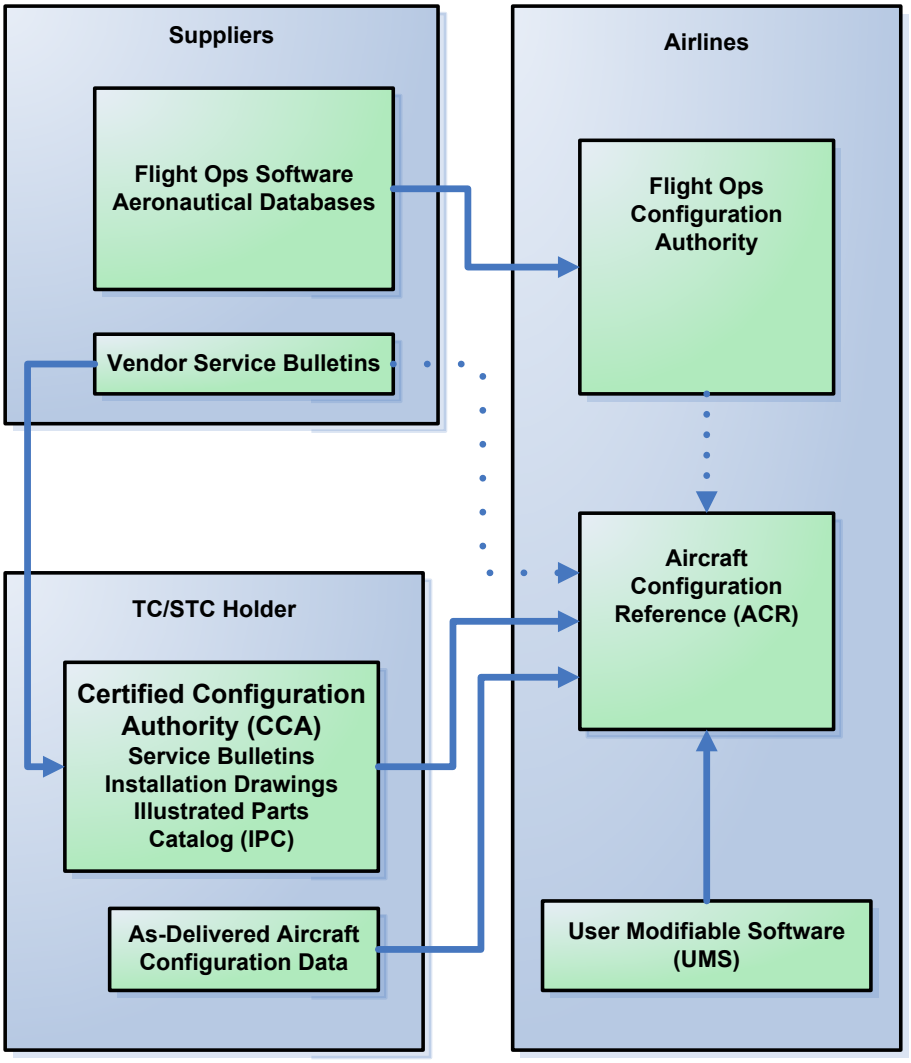


Figure 8-1 – Configuration Authority Responsibilities

TC/STC holders have the responsibility for the CCA for their respective aircraft or systems through the life of the aircraft. They are responsible for identifying the TC or STC configurations available to airlines. This will include the SB references that replaced one certified configuration with another.

The aircraft manufacturer provides “as-delivered” configuration data to airlines that identifies the configuration of the aircraft at time of delivery and is used as the baseline for the ACR. IPC/IPD data is then updated by the TC/STC holder on a regular basis. **ARINC Specification 843:** *Aircraft Software Common Configuration Reporting* defines the process and format for generating a software configuration report from an aircraft or a mass storage device

The airline is responsible for the ACR for any changes to the aircraft after delivery, for the entirety of time they operate the aircraft.

Suppliers of certain systems (e.g., IFE) are responsible to manage the FAA Part 25 or EASA Part 25 system CCA related to their ACS from time of aircraft ticketing through the life of the aircraft.

8.2 Establishing the Airline Configuration Reference (ACR)

8.2.1 Understanding the CCA

The aircraft manufacturer will provide as-delivered configuration data to identify the certified aircraft configuration for each aircraft at time of delivery to the airline.

Modifications to the certified configuration are incorporated through manufacturer or supplier provided SBs or operator originated modifications based upon the STC process, minor modification processes, or operator engineering paperwork (such as EOs). More than one aircraft software part number for a given software function may be certified to be used with a specific target hardware and allowed to be used, just as more than one hardware part number for a given hardware function may be allowed to be installed on a given aircraft.

The CCA provided by the TC/STC Holder (aircraft manufacturer or supplier) to airlines captures the allowable Part 25 hardware and software changes to each aircraft in an airline’s fleet. New changes typically originate in SBs and Airworthiness Directives that once released get incorporated into the CCA as represented by the IPC or equivalent electronic system. The scope of the CCA is typically limited to Part 25-certified components.

The CCA also identifies compatibility and mixability related to software and hardware. The CCA is not intended to fully define the ACR.

COMMENTARY

With the increased use of Integrated Modular Avionics (IMAs) as well as Commercial Off-The-Shelf (COTS) software (such as operating system software), it is believed that Software-Software Compatibility and Mixability dependencies will become more prevalent. Compatibility and mixability checks are often performed automatically by the loadable systems but are also captured in the CCA to ensure compatibility and mixability issues do not arise during the loading process.

In the past, the CCA was documented in the paper-based IPC and SBs. This data is now captured in S1000D IPD and SB Publication Modules.

8.2.2 Creation of the ACR

The Certified Configuration Authority captures the in-service authorized ACS and inter-related hardware configuration for each aircraft in the airline's fleet. The ACR reflects the changes to an airline's aircraft configuration from the original CCA. These changes may include FAA Part 121 ACS and airline-generated UMS not represented in the CCA.

An ACR should use the CCA as an input for defining an airplane's required configuration. It is important to note that there are other sources of configuration information such as airline internal requirements, periodic database updates, UMS, etc.

ACR data primarily defines ACS installed and operating in target hardware. In addition, airlines should consider how ACR data is maintained for onboard MSDs that act as spare parts software storage. It is recommended that each instance of an ACLSP stored in an onboard MSD would be authorized in the ACR. It should be noted that ACS is allowed to be stored on onboard MSDs, even if the software is not also installed in aircraft target hardware as long as the ACS is not obsolete (i.e., not allowed to be installed) or have safety concerns (e.g., as outlined in an Airworthiness Directive (AD)).

An important consideration is whether the airline allows only one software configuration to be installed and maintained by line maintenance or whether choices of compatible HW and SW will be allowed to be made by line maintenance. Use of one configuration is easier to maintain and clear but less flexible during line maintenance repairs. Line maintenance must contact Engineering to install alternate HW and SW in this case.

It is possible that an ACR for Type Design Software (LSAPs) may be separate from the ACR used for Operationally Approved software. For example, an independent Flight Operations Configuration Reference (FOCR) could be established for managing flight operations software. Other Configuration Authorities could exist for items like Aircraft Support Data.

Airlines are encouraged to use software configuration management tools (e.g., an EDMS) to manage their ACR for modern complex aircraft. Many good Commercial Off The Shelf (COTS) products exist that perform this function and can be modified to fit an airline's business process. CCA information can be input into the CM tool as a source for the ACR. It is highly recommended that the CCA information be distinguishable from the ACR information to preserve the integrity of both authorities.

The Software and all relevant documentation (FAA/EASA forms, CoC, etc.) related to the respective Software Part should be linked in the ACR.

8.2.2.1 ACR Software Configuration Data

The following information should, at minimum, be considered for inclusion in the airline's ACR for managing each ACLSP:

- Software Part (ACLSP) Number
- Software Part (ACLSP) Nomenclature
- SLID (if used)
- SLID Nomenclature (if used)
- FIN (if used)

- FIN designation (if used)
- Target Hardware Compatibility (if needed)
- Aircraft IDs (i.e., identification of aircraft where the part is installed)
- Aircraft Model
- Media Set Part Number (if used)

8.2.2.2 Use of IPCs

There is a perception by some that the IPC issued by TC/STC holders is an ACR rather than a CCA. The IPC issued by TC/STC holders (or other CCA data) may not act as an ACR for an airline for the following reasons:

1. The CCA does not define that the latest certified configuration for a particular system is the configuration that is installed. This is a choice that the airline needs to make. The airline could choose to reject certain changes. The CCA contains no airline change or state management data. Often the ACR shows pre-SB and post-SB changes which are in the process of being incorporated in various aircraft.
2. The CCA generally does not capture Non-Type Design software configuration changes.

It is possible for a modified IPC to act as the ACR provided the above capabilities are addressed. Those modifications would then make the revised IPC an ACR rather than a CCA.

8.3 Software Change Management

Managing the configuration of ACS for-aircraft in-service involves a number of stages. These stages include aircraft delivery, aircraft change management, software installation, and software verification processes. These processes are described below.

Aircraft delivery is the initial stage of an aircraft's configuration management life cycle. The importance of this stage is to ensure the proper transition of the aircraft baseline configuration from the aircraft manufacturer CM process to the airline CM process. Standardized XML (via a standard schema) is the preferred data format to facilitate that transition.

8.3.1 Standard Configuration Change Process

For most in-service ACS changes, the airline should follow a standard configuration control process as follows. Changes may come from various sources, including but not limited to:

- Aircraft manufacturer-issued SB
- Supplier-issued SB
- STC based modifications
- Airline Generated Changes (AGC) to supplied FAA Part 121 or EASA AIR-OPS software (e.g., Aeronautical Databases)
- AGCs to airline created parts (e.g., UMS)

Changes issued by SB get periodically incorporated into IPC/IPD and published to airlines as incremental CCA data. Airlines in some cases have the option to reject or delay incorporation of SBs on their aircraft. AGCs are solely captured in the ACR.

Airlines therefore need to define the current authorized ACS configuration for their aircraft resulting from all of these sources in the ACR.

Each change to the ACR should capture:

- The authorizing source (SB, AD, etc.)
- Approval of the change from the appropriate department
- ACS to be installed and ACS to be replaced

Once approved, ACS changes may be accompanied by the airline's EO. The EO initiates the processes of determining whether the part needs to be ordered, distributing the part to the appropriate onboard MSD, installing the part in the appropriate target hardware, and verifying all part distributions and installations.

At the end of the approval process, FAA Part 25 and EASA CS 25 changes originating from the TC/STC Holder should have both a SB and an EO. Some of these changes will also have an AD to remove the existing parts. AGCs (i.e., FAA Part 121 and EASA AIR-OPS changes originating from suppliers or airlines) should have an EO at minimum.

8.3.2 Rapid Configuration Change Processes

Airlines should have a configuration control process for configuration changes that may require rapid deployment of new ACS. These processes may be applied based on a situation, such as a component replacement and software installation at a gate turn or may be associated with certain loadable software types.

Some examples of these loadable software types include, but are not limited to: NDBs, terrain database, or special case User Modifiable Software (e.g., Certificate Revocation List). The following configuration management guidelines should be followed as a minimum for rapid configuration change processes:

- Configuration Reference: The ACLSP must be approved for installation on the aircraft. This approval should be in the form of an Engineering Authorization or a pre-defined configuration authority reference listing that allows alternate hardware and software configurations. The ACR may need to be updated following the change.
- Configuration Verification: The part number of the ACLSP should be verified once it has been loaded into the target hardware per applicable data load instructions.

8.3.3 Distribution and Installation Control

During Scheduled and Unscheduled Maintenance activities, the outcome of the Configuration Change process may result in the generation of Engineering Orders (EOs) to distribute and install software. EOs should always include steps to verify correct software distribution and installation.

8.4 Aircraft Software Configuration Verification

Aircraft software configuration verification is the act of comparing the aircraft configuration reference (the ACR) to the actual aircraft configuration to ensure that the correct ACS is installed following any loadable system installation activity. The methods approved to verify the part numbers of ACS installed in target hardware are those described in the AMM. Generally, aircraft software configuration verification can be performed in one of two ways:

- Visual Verification: Visually checking configuration display screens against a paper or viewable electronic report of the ACR
- Automated Verification: Use of an automated tool to perform the checking function.

8.4.1 Periodic Configuration Audits

For software-intensive aircraft, there is a need for an overall aircraft-level audit activity from time to time. This verification is intended to cover all installed software on the aircraft and/or all software stored in MSDs. Due to the quantities of ACLSP instances involved, it is highly recommended that an automated tool be used to perform this type of check. Newer aircraft should be designed to support this automated checking function. Each airline should discuss the appropriate use of this type of verification audit with their regulatory authorities.

Operators should consider doing an aircraft-level overall audit verification in the following situations:

- As part of a scheduled or unscheduled maintenance event involving multiple systems ACS installations
- As a periodic audit with the time frame to be determined by each airline and their regulatory authorities

8.4.2 Automated Verification

In order to perform automated verification checks for an aircraft, the following is needed:

- Aircraft Configuration Data: Configuration data extracted from the aircraft. Data should be available for all aircraft installed software (i.e., software installed in target hardware) and for each MSD on the aircraft. The preferred format of this data is via XML per ARINC Specification 843.
- Airline Configuration Reference Data: Configuration data extracted from the airline's Configuration management systems. Data should be available for all aircraft installed software (i.e., software installed in target hardware) and for each MSD on the aircraft. The preferred format of this data is via XML.
- An automated configuration comparison tool (software application) that uses the above source data to identify discrepancies between aircraft and authorized configuration for each identified.

In order to perform the comparison function, the availability of the following configuration data elements is important:

- Software Part Number
- SLID
- FIN
- Validity Period (where applicable, e.g., Nav Database (DB))
- Aircraft ID (i.e., identification of aircraft where the part is installed)
- SB/EO software planning status (for planned software changes)

COMMENTARY

If the configuration comparison tool can check for hardware/software compatibility errors, it may be necessary to obtain hardware part numbers and hardware

locations. Such compatibility errors might be checked directly in an authorized configuration tool as part of generating the ACR rather than in a comparison tool.

The following data elements are recommended but not required for each of the above configuration data inputs in support of the comparison function:

- Software Part Nomenclature
- Software Location Description
- Target Hardware Nomenclature

COMMENTARY

As newer, more complex aircraft become more widespread, automated verification may become a required activity.

Figure 8-2 shows how an automated configuration check may be carried out using a wired or wireless link from the aircraft to maintenance or flight operations. The check can be initiated by maintenance/flight operations or by a mechanic performing maintenance on an aircraft.

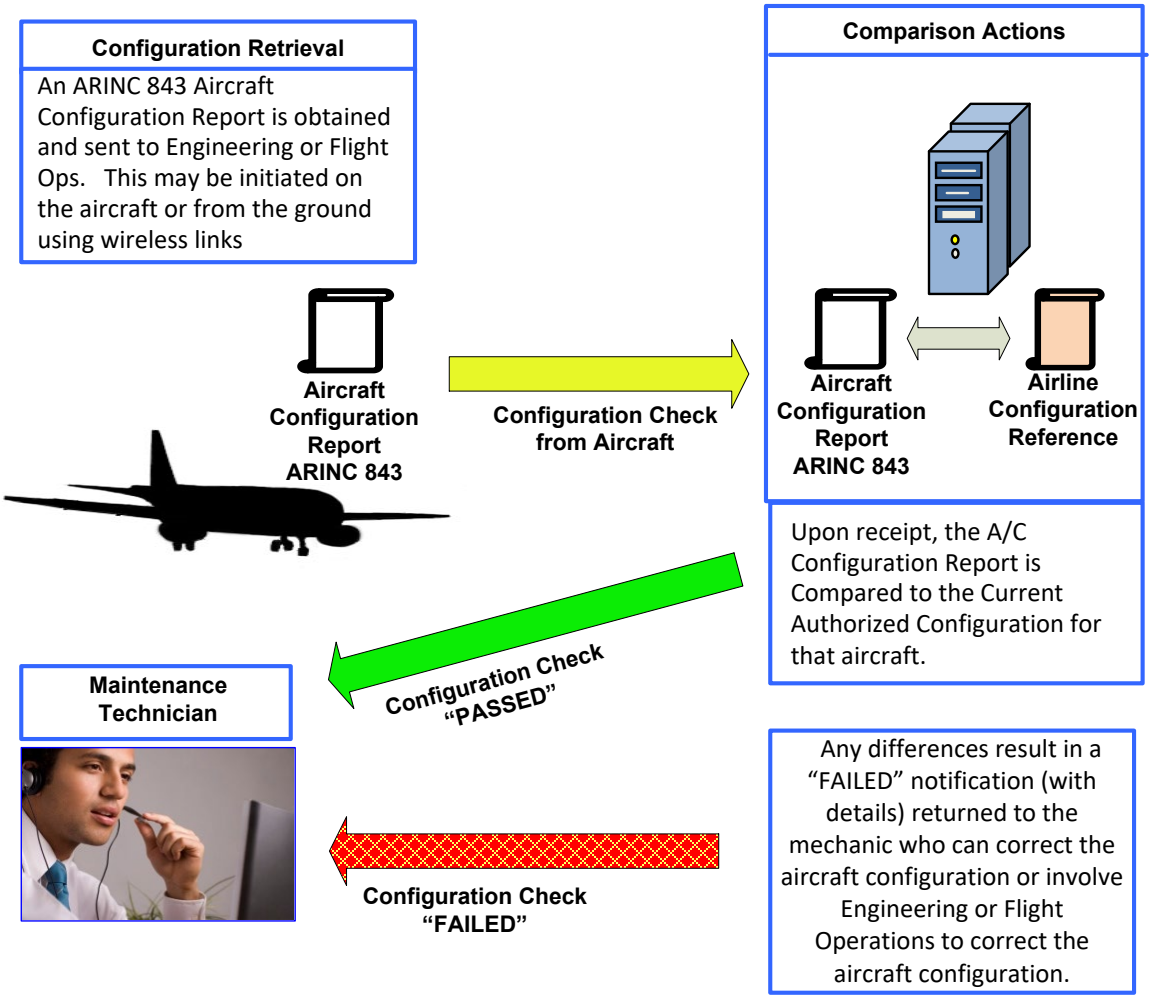


Figure 8-2 – Example of an Automated Configuration Check

8.4.3 Software Installation Locations

Airbus and Boeing differ on their method of identifying software locations when an instance of software could exist in more than one system.

Airbus uses the term Functional Item Number (FIN).

Boeing uses the term Software Location Identification (SLID).

8.4.3.1 Functional Item Number (FIN)

A FIN is unique for the whole Aircraft. The FIN concept applies to Software and Hardware. Software is always hosted by Hardware. A Hardware FIN hosting Software FINs is always identified as such, meaning that for each hardware FIN, the list of installed software is indicated and linked to the Hardware FIN. Information is available in the IPC provided by the CCA.

8.4.3.2 Software Location Identification (SLID)

Software installation location represents a concept which defines the relationship of installed software to installed target hardware. Software installation location identifies where software is installed in the aircraft for purposes of confirming that the aircraft is in the proper configuration.

A given software installation location (SLID) may represent one of four scenarios:

- A particular target hardware location
  - Example: Left CTC
- A particular channel of a particular hardware installation
  - Example: Left CTC Chan A
- A memory load site within a particular target hardware location
  - Example: Left CTC Chan A OPS
- Multiple target hardware locations within a system
  - IFE Seatback Units

Note that multiple ACLSPs might be installed to a particular SLID if the SLID is not memory load site specific. The SLID nomenclature helps describe the scope of the SLID. The ACR and AMM should describe what each SLID represents for a given aircraft.

COMMENTARY

Note that multiple ACLSPs are not installed into a particular SLID when an SW-FIN is used.

Note that a SLID representing multiple target HW locations implies that the system tracks the specific software locations internally and a fault or system configuration error display will indicate any issues within the system. The AMM will describe how to resolve system configuration errors in these cases.

Note that a SLID has no meaning outside of the aircraft. If ACLSP A is loaded to the Widget component in the shop, it cannot be verified against a SLID until the component is installed in an aircraft. An airplane may have a Left and Right Widget component. To properly dispatch an aircraft, it must be verified that the aircraft has a Left Widget (SLID LW) containing ACSLP A and a Right Widget (SLID RW) containing ACLSP A. This can only be confirmed on an aircraft.

8.4.4 ACS Verification During Hardware Replacement

Whenever loadable hardware (hardware which accepts ACS) is replaced, an aircraft software verification must be performed per the AMM.

If the ACS part numbers pre-loaded in the hardware are correct for the aircraft, then no further action is required concerning the software. If the ACS part numbers pre-loaded in the hardware are not correct for the aircraft, then the correct ACS part number(s) must be installed. Authority for determining correct ACS part numbers is the airline's ACR.

8.5 Compatibility, Interchangeability, Mixability

8.5.1 Compatibility

Compatibility: The ability of software to properly function in a target hardware environment.

The concept of hardware with its installed ACLSPs on a given aircraft is considered to be a target hardware environment.

If an ACLSP will not function in a particular target hardware environment, it is said to be incompatible with that target hardware environment and should not be installed.

In order to determine Compatibility, testing and certification needs to be performed to ensure that a new hardware-software or software-software combination works together without error for each aircraft type.

There are four types of compatibility related to software:

1. Hardware-Software – refers to whether the software part will function properly when installed on a particular target hardware part.
2. Software-Software – refers to whether the software part will function properly when used in conjunction with other software parts in a specific hardware unit.
3. Airplane-Software – refers to whether the software part will function properly on a particular aircraft major or minor model.
4. Cross-Unit – refers to whether the software part will function properly based on other target hardware configurations. For example, some systems require that the same ACLSPs are present in all redundant units.

Figure 8-3 illustrates the relationship between hardware and software compatibility for a particular hardware unit.

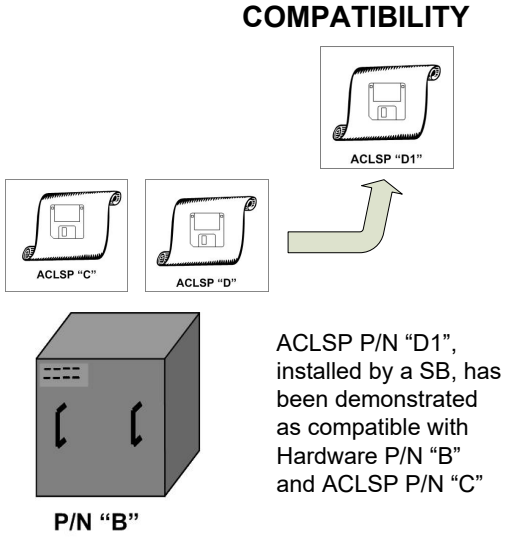


Figure 8-3 – Example of the Compatibility of Hardware and Software

8.5.2 Interchangeability

Interchangeability: The ability of an item (e.g., SW part, HW part) to replace another one without alteration and fulfill the same requirement. The form, fit, and function remains exactly the same when an alternate choice of hardware or software is made. Hardware parts may be interchangeable with other hardware parts and ACLSPs may be interchangeable with other ACLSPs.

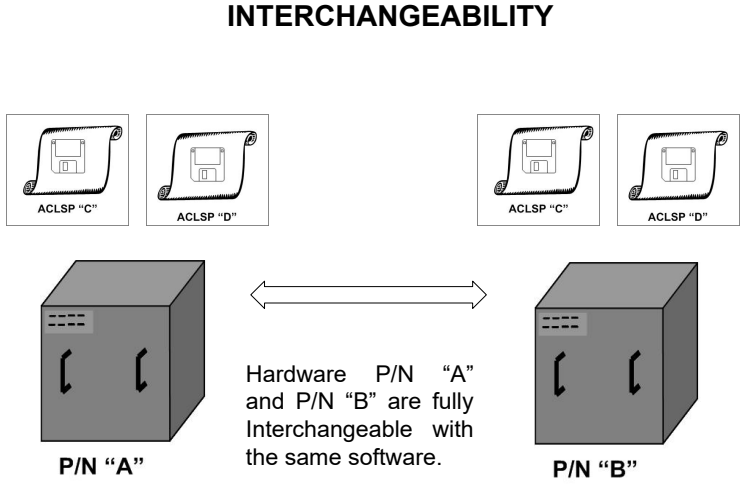


Figure 8-4 – Example of the Interchangeability of Hardware and Software

COMMENTARY

ACLSP interchangeability is usually discouraged by the airlines because of the cost of maintaining multiple configurations and the resulting configuration management issues.

8.5.3 Mixability

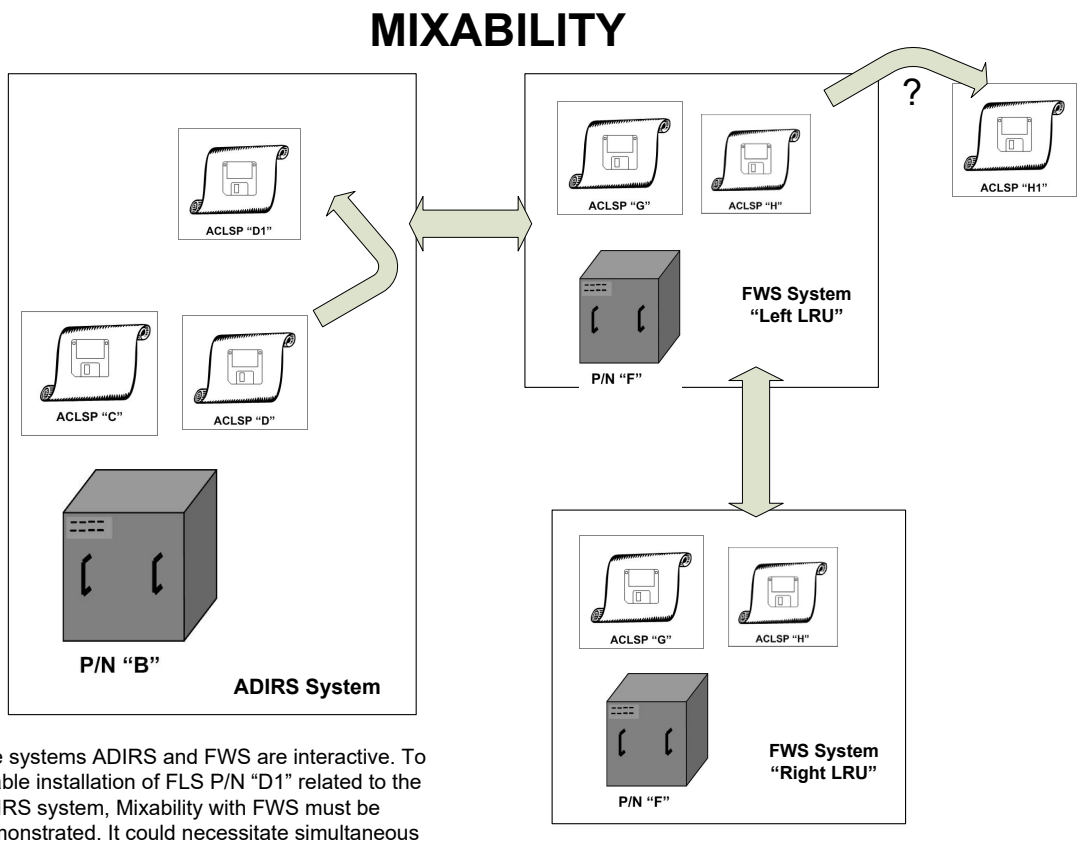
Mixability: Mixability refers to compatibility between two or more different hardware units or systems.

- Mixability can be intra-systems (i.e., between target hardware within the same system)
- Mixability can also be inter-system (i.e., between target hardware in different systems) compatibility

This is the ability to modify one or several entities, belonging to one or more different interacting target hardware units, and fulfill the same overall requirement.

In order to determine Mixability, one needs a full knowledge of the modifications impact on all hardware and systems. Issues linked to Mixability frequently result from overlooking hidden functional dependencies between different systems developed by different design organizations.

Figure 8-5 below illustrates the relationship of hardware and software in the case of mixability.



The systems ADIRS and FWS are interactive. To enable installation of FLS P/N "D1" related to the ADIRS system, Mixability with FWS must be demonstrated. It could necessitate simultaneous installation of FLS P/N "H"1 related to the FWS

Figure 8-5 – Example of the Mixability of Hardware and Software

8.6 Off-Aircraft Software Configuration Activities

8.6.1 Shop Load Verification

ACS may be installed into loadable components in a shop. The shop load process may be able to verify that the ACS installed into a particular component which is intended to go a particular aircraft is correct. Shop load verification does not remove the need for aircraft-level verification since the component may or may not get installed in the intended aircraft and the intended aircraft's configuration may change by the time the component gets installed creating an interchangeability or mixability issue.

8.6.2 Verification of Pre-Loaded Software

Pre-loading of software in target hardware by hardware suppliers for delivery to an airline is a common practice. In this case, the software configuration must still be verified upon installation of the target hardware on the aircraft.

COMMENTARY

The part number of ACS that is pre-loaded may be indicated on a tie-on-tag or 8130 form information block, but this does not relieve the requirement for verification once the target hardware is installed on the airplane.

8.7 Configuration Records Retention

All records of all types of configuration verification activity should be retained for a certain amount of time negotiated with the applicable regulatory authorities. The operator's CM system should have the capability to retrieve aircraft configuration reports for various points in the past as part of records retention.

9.0 ACS LOADING METHODS

9.1 ACS Loading Philosophy

Airlines desire fast aircraft software loading from centralized locations on the aircraft with all software loads performed in a similar manner.

COMMENTARY

An exception to centralized loading is the case of directly loading target hardware, when the limitations of the data bus would unacceptably increase the time required for dataloading.

This is commonly accomplished through the utilization of a target hardware's front panel data port, if so equipped. Airlines desire that component suppliers use ARINC interface standards.

In the case of legacy aircraft, centralized data loading may not be possible due to a lack of central capability.

Airlines desire the ability to load both onboard and off-aircraft (in the shop).

Airlines desire the ability to load ACLSP in the flightline operational environment with minimal impact to dispatch reliability if the ACLSP cannot be loaded within a 'short' turn-around time.

During unscheduled maintenance when software loading is cannot be accomplished and is due to replacement of a host or target hardware, the MEL could be utilized for guidance on disabling the affected hardware to potentially allow airplane dispatch.

Relief should be provided to allow the software to be reloaded when extended ground time can be scheduled.

COMMENTARY

Sizes of ACLSP have grown significantly over the years due to increased complexities and higher level of integration of onboard functionalities which may result in longer load time per software load set or media set. This can have an impact on the airlines' ability to accommodate software loading in the flightline operational environment.

9.2 Loading Resources

The ACLSP may be loaded into the target hardware onboard an aircraft using a PDL, ADL, or a software loading application on an airborne server.

Another onboard method is known as cross-loading, whereby an onboard component loads its redundant counterpart onboard the aircraft.

An off-aircraft loading tool (i.e., shop loader) may be used to pre-load target hardware prior to hardware installation on an aircraft.

In each of these cases, the ACLSP numbers must be verified onboard the aircraft using established processes and procedures.

Distribution of software parts to designated software load points (e.g., aircraft MSDs, PDL file server, Shop Loader file server, etc.) is discussed in Section 6.0.

While ACLSP electronic distribution to aircraft MSDs and file servers is rapidly moving into mainstream practice, it is not to be confused with loading of target hardware (software loading).

All onboard software loading is performed under direct human supervision and control with a person physically located onboard the aircraft. Many times, software loading can induce system or hardware faults which also requires human supervision of the loading process.

Some airlines choose to gather the resources at a forward point for scheduled loads. The practice of staging software in preparation of loading operations is purely for efficiency. The infrastructure required for software distribution and security needs to be considered when introducing this practice into line operations. This includes the security of the wired and wireless technology used for software distribution.

9.2.1 Security of Software Management

Aircraft information security is required to be included as part of aircraft operations and maintenance. The effects of information security threats can affect aircraft safety. There are required activities in the operation and maintenance of aircraft related to information security threats.

Aircraft software management is the primary common activity that can potentially impact aircraft information security. Risk management is becoming an increasingly important operator function within the scope of airborne software management.

In some instances, operators are required to develop an Aircraft Network Security Program (ANSP) in accordance with:

- RTCA DO-355/ED-204: Information Security Guidance for Continuing Airworthiness
- FAA AC 119-1 – Airworthiness and Operational Approval of Aircraft Network Security Program (ANSP)

These requirements are to make a full assessment of their operational security, including all aspects and processes regarding aircraft software loading and management, and additionally aircraft support systems such as ground support systems used as part of aircraft software storage, distribution, loading, and control.

Integrated security efforts are increasingly important with software intensive aircraft. These are aircraft that have systems that employ server functions for the flight avionics and the cabins systems, as well as aircraft that have connections with ground systems and tools.

9.3 Software Load Status Information

The software load should be performed with the assistance of load status information that is electronically displayed on the aircraft or at the software loader itself. This information represents the progress of the load including load completion or load failures. The status information should be in accordance with ARINC Reports 615, 615A, and **ARINC Specification 826:** *Software Data Loader Using CAN Interface*.

9.4 Software Loading Procedure References

The AMM is the primary approved loading reference document for software parts loaded on the aircraft. For software loading off the aircraft, the CMM is the approved reference.

Software load procedures may also be found in SBs, airline-produced EOs, work orders, standard practice manuals, or other acceptable methods. These documents should be approved in the airline's quality assurance system using the rules of the airworthiness authority valid for the particular aircraft operator prior to use.

Airlines use their internal EO process to document and authorize software configuration changes for an aircraft (ACLSP) or aircraft part (HCLSP). The SB can be the basic reference for an airline-produced document (e.g., EO and WO). However, the SB is not used as the sole loading authority and procedure reference.

9.4.1 General Loading Procedure

Generally, the process of software loading includes the following steps:

- Identification of the intended software installation locations
- Identification of the software parts to be installed
- Identification of the sequence, if more than one software part needs to be installed and if the sequence matters
- Initiating the software load process
- Monitoring the load process and responding to software load messages
- Verifying that the correct software part number(s) are installed and in the correct location(s)

9.4.2 Additional Loading Considerations

When attempting to repair a system by replacing faulty target hardware, a fault history capture (including fault indication messages) should be performed in case the box needs to be removed for off-aircraft troubleshooting and maintenance.

Additionally, the airlines have found that accomplishing a power up test on a component prior to a software load is also recommended to ensure the target hardware is serviceable.

9.5 Hardware Pre-load

Software can be pre-loaded into hardware in a shop or line maintenance area prior to installation of the hardware in the aircraft.

When the airline requires a pre-load in the target hardware, the shop or component mechanics are responsible for checking and loading the requested ACLSP. They need access to the requested ACLSP, loading procedures, tools, and test equipment necessary to load the target hardware.

Preloaded software must be verified by the technician installing the component on the aircraft at the time of installation. An ACLSP that cannot be electronically verified on the aircraft (aircraft display, dataloader display) cannot be preloaded prior to aircraft installation.

COMMENTARY

If an airworthiness directive or a safety related issue directs removal of obsolete or superseded software, steps need to be taken to ensure that target hardware is not preloaded with the affected software.

An airline may choose to establish ACLSP pre-loads for particular hardware part numbers. Airlines will need to coordinate with each affected designated repair station to ensure that common processes are established to update, verify, and maintain records conveying requests for standard ACLSP pre-loads.

An airline may choose a particular ACLSP version for preloading a piece of target hardware. For example, if an airline has 40 of 50 aircraft with a specific software revision, the airline would likely choose to preload target hardware with that specific revision.

Any shop-loading or preloading instructions should be contained in the applicable CMM.

9.6 Software Part Number Verification

Software part number verification is an essential step and required in verifying that the intended software is loaded on the correct target hardware (as designated by the software installation location) and is appropriate for the aircraft. Verification that ACLSP conforms to the approved aircraft configuration must be performed on the aircraft by the maintenance technician after software is loaded. The verification procedures are published in the applicable software loading procedures.

The software part number verification should be displayed on the aircraft or on the data loader. Software configuration information may also be reported through wired (laptop or PDL) or wireless methods (e.g., ACARS, Terminal Wireless LAN Unit, Ground Link, etc.) to a ground system.

9.7 Software Installation Approval

After the software installation is performed, the aircraft release to service is signed-off by authorized personnel, with the stipulated qualification according to the quality assurance documentation based on the rules of the airworthiness authority valid for the particular aircraft operator. Software sign-off and documentation requirements correlate to software classification per Figure 2-2. Each airline prescribes their sign-off requirements and process for each software type.

9.8 Onboard Software Load Time

The airlines desire the fastest load times possible. The following information provides guidance to equipment manufacturers regarding the load times that are considered to be acceptable:

a. It is desirable that the full ACS complement of a single target hardware item be loadable within a 15-minute period. This may not be possible for all systems. Some exceptions include IMA systems, aircraft network servers, electronic flight bags, IFE, etc.

b. Periodic ACS updates such as the 28-day NDB should be loadable within a 15-minute period. This is for one target hardware part only. For other target positions or doing a cross-load, more time will be required to complete the loading of a shipset.

c. When it is necessary to perform a planned system upgrade, it is desirable for the complete system load to be accomplished in less than four hours. In this case, there could be multiple ACS parts and several target hardware items with their full complement of ACS. Upgrading a complete IMA system is an example.
d. It is desirable that the Airframe Manufacturers or OEMs provide guidance on load times for all loadable systems and/or parts.
e. Airframe Manufacturers or OEMs should provide dispatch relief (e.g., MMEL) when the system can be operated safely but without particular ACLSPs installed.
f. It is desirable that Airframe Manufacturers or OEMs provide guidance on rapid recovery of software part distribution to aircraft network servers in case of server failure.
g. It is desirable that Airframe Manufacturers or OEMs provide the load times for software parts and data.

9.8.1 Definition of Onboard Software Installation and Load Time

Onboard software load time is the duration of time it takes to perform the onboard load procedure as defined in the AMM using the primary software load scheme. Use of auxiliary load (shop loading, preloading, etc.) methods in conjunction with the primary software load scheme to reduce the stated load time, while feasible in some cases, cannot be part of the stated load time. Load time cannot be reduced by taking credit for auxiliary load methods.

The total onboard software installation process may consist of several distinct sequential elements as defined by the AMM. While each sequential element cannot be measured precisely, it is only an indication on the sequential elements. Users are not expected to be able to measure the time taken for each element being executed. Figure 8-1 graphically shows the elements involved with software installation and loading.

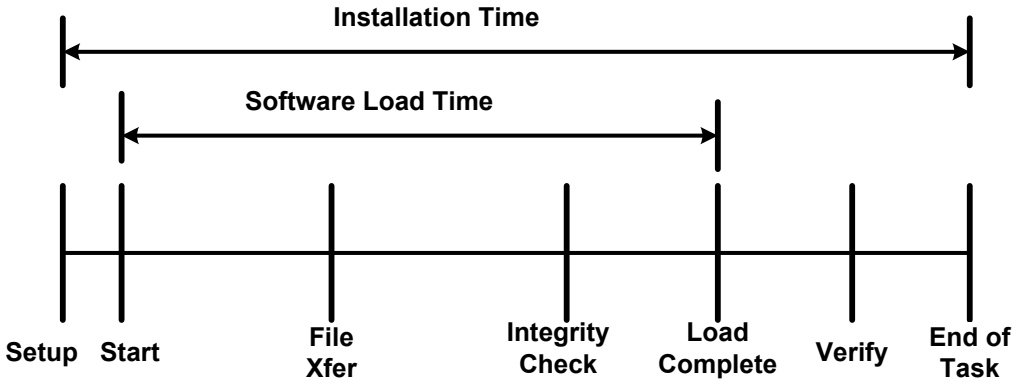


Figure 9-1 – Illustration of Installation and Software Load Time

The following assumptions are expected before and during software loading:

- The aircraft is powered
- An experienced maintenance crew is available
- The software and any required software loader are available on the aircraft
- The software load is successful on the first try

9.8.1.1 Setup

This step may involve certain tasks prior to software installation such as:

- Researching the required software and Media Set Part numbers using IPC, IPD, etc.
- Collecting tools, adapters, ground equipment
- Retrieve AMM maintenance procedures for data load tasks
- Retrieving media sets, if necessary
- Ensure correct software part number(s) are on the MSD source if necessary
- The user is required to select the desired software part number(s) and hardware target(s) on the data loading device

This step is not included in software load times, but is very important to be efficient to allow the maintenance time on a software installation task to be as short as possible.

9.8.1.2 User Initiation – Start

The user initiates the loading process.

This step starts the load time, and the expectations in Section 9.8 would apply.

9.8.1.3 File Transfer

Once initiated with desired software part number and target hardware, the file transfer to the target hardware would then begin. In the case of an onboard server equipped aircraft, the software would be transferred from the loadable media or the onboard server repository. The user interface should have an indicator which illustrates the progress of the transfer.

This step is included in software load times, and the expectations in Section 9.8 would apply.

9.8.1.4 Integrity Check

On completion of the transfer, the software would be stored in the allocated memory and then enter into execution mode. On completion of the programming, an integrity check would be initiated. The results should be reported back to the designated display or software loading console.

This step is included in software load times, and the expectations in Section 9.8 would apply.

9.8.1.5 Load Completion

This is the time it takes the component to reboot and display a load completions status message. In some cases, an component will display the status before rebooting, or it may reboot then display the status message.

This step concludes the software load time, and the expectations in Section 9.8 would apply.

9.8.2 Verification – Configuration display

The user should be able to verify the software configuration of the target hardware on the aircraft interface, PDL, portable maintenance device, or other means as specified in the AMM.

This step is not included in software load times but is very important to be efficient to allow the maintenance time on a software installation task to be as short as possible.

9.8.3 End of Task

This would include paperwork, closing out the work order, returning to service (if required), etc. This step is not included in software load times but is very important to be efficient to allow the maintenance time on a software installation task to be as short as possible.

9.8.3.1 Return to Service

It may be necessary to configure, enable, or test features of a system following a software load. The procedures specified in the AMM should be followed.

It should be noted that most systems do not require tests after ACS load if the equipment has not been removed from the airframe. Return to service targets can be specified separately. For flight systems, operational checks are required.

Software load time does not include time taken to carry out return-to-service tests.

9.9 Off-Aircraft Software Loading

When the ability to preload exists, aircraft manufacturers and OEMs should design and implement their systems not to exceed the maximum loading time for onboard loading.

The airlines are interested in the total time necessary for the mechanic to perform the task. Some systems, for example, take significant time to enter and exit a software load mode or to perform necessary integrity checks and startup tests following the data transfer. These times need to be included in the definition of software load time if it is to achieve the identified objectives. In any case, the software load should succeed on the first attempt.

For more information about off-aircraft data loading, reference ARINC Report 849.

10.0BORROWED AVIONICS AND ASSOCIATED SOFTWARE

10.1 General

For operational reasons, an airline may choose to borrow aircraft equipment from another airline. This borrowed equipment may contain ACS. This practice is often used to assure timely aircraft dispatch when the airplane is away from its base of operation. Airlines and MRO organizations expect this practice to be timely and efficient.

COMMENTARY

In many cases, it is not possible for embedded software to be removed from a borrowed unit. Therefore, the practice of borrowing hardware implies the borrowing of software.

Under normal circumstances, airlines take the necessary steps to ensure that the ACS is in accordance with the certified aircraft configuration. If the ACS resident in the borrowed part is not in accordance with the certified aircraft configuration, the borrowed equipment must be loaded with the correct ACS. Exceptions are defined under Section 10.4, Contingency (Get You Home) Maintenance.

10.2 Responsibilities of Airlines and Third Party Service Providers

The airlines and MROs may install borrowed target hardware and upload the appropriate ACS in accordance with the AMM or an airline/MRO produced document (i.e., EO, WO). These organizations must comply with the rules of the airworthiness authority valid for that particular aircraft or operator.

It is possible that borrowed target hardware may be loaded with an ACS that may or may not be approved for the aircraft requiring the hardware. Any tag or other delivery document accompanying the target hardware should be used as information only and not to verify the version of the ACS. Verification of the ACS must be performed in accordance with AMM.

10.3 Borrowing Avionics Software

On occasion, it is desirable for airline operators to borrow a copy of ACS from another airline or MRO. In this situation, the software is treated in a similar manner as hardware. Provided the software is the version approved for use on a specific aircraft, the borrowed software may be loaded. The software supplier should consider this practice to be within the scope of normal use.

The practice of borrowing or loaning software (or equipment containing software) may be subject to import and export control regulations. These may also be subject to contractual obligations, and these two issues should be considered when developing a policy on hardware and/or software borrowing.

10.4 Contingency (Get You Home) Maintenance

Multiple ACS part numbers exist to satisfy various combinations of target hardware functions, options, and approved installations. Therefore, there is a possibility that loaned target hardware will have an approved but different ACS from the airline’s defined aircraft configuration.

Use of ACS that is not part of the airline defined configuration of the aircraft is not allowed with the exception of an engineering approval. This approval will be issued by the engineering organizations of the aircraft operator and the aircraft

manufacturer. The decision of the operator is based on the rules of the airworthiness authority valid for the particular aircraft/operator.

The ACS should be loaded in accordance with the certified configuration at the next suitable maintenance opportunity.

APPENDIX A EDMS CONCEPT

Electronic Data Management System: A system for capturing and administering an ACR. The minimum capabilities of an EDMS are those capabilities required to manage an ACR and are described in this appendix.

The EDMS is expected to use and be consistent with the CCA data provided by the TC/STC holder. Note that if an electronic system exists for managing the CCA provided by the TC/STC holder, then ACR capabilities could be built on to that system to manage both Configuration Authorities under a single system. In that event, it is recommended that data components in the EDMS be clearly identifiable as applicable to CCA or ACR. The CCA data should not be modifiable by airlines.

A-1 EDMS Concepts and Capabilities

Airlines may use any method they choose to manage their ACR data, including using paper-based (word processor programs, data tracking, etc.) alterations to the TC/STC Holder-provided CCA, alterations of S1000D XML Publication Modules, etc., as long as they can show change and state management control of their aircraft configurations. This is not recommended, however, for aircraft with large quantities of ACS onboard as these mechanisms become difficult to manage over time. Instead, airlines are recommended to establish an EDMS as defined below.

An EDMS should implement the capabilities described in Section 8.0. In addition, the EDMS should be capable of performing the following functions:

- Allow import of a baseline “as-certified” configuration report at time of aircraft delivery via an XML import function.
- Allow manual input through a user interface of aircraft manufacturer SBs, Supplier SBs and/or IPC data. At minimum, the data in Section 7.5.2 should be capable of being input. However, CCA data may be optionally included. If included, this data should be Read-Only and must be synchronized to existing ACR data.
- Allow import of S1000D IPD and/or SB Publication Modules via an XML import function. At minimum, the data in Section 7.5.2 should be capable of being imported. If included, this data must be synchronized to existing ACR data.
- Allow manual input through a user interface of AGCs to aircraft.
- Allow export of EOs for use in generating Work Orders.
- Allow export of Authorized Configuration Reports in human readable and in XML form for use in Aircraft-Level Configuration Verification tasks (see Section 8.3).
- Allow automatic verification of SW configuration status for each aircraft (comparison of planned and real SW configuration on aircraft level).

APPENDIX A
EDMS CONCEPT

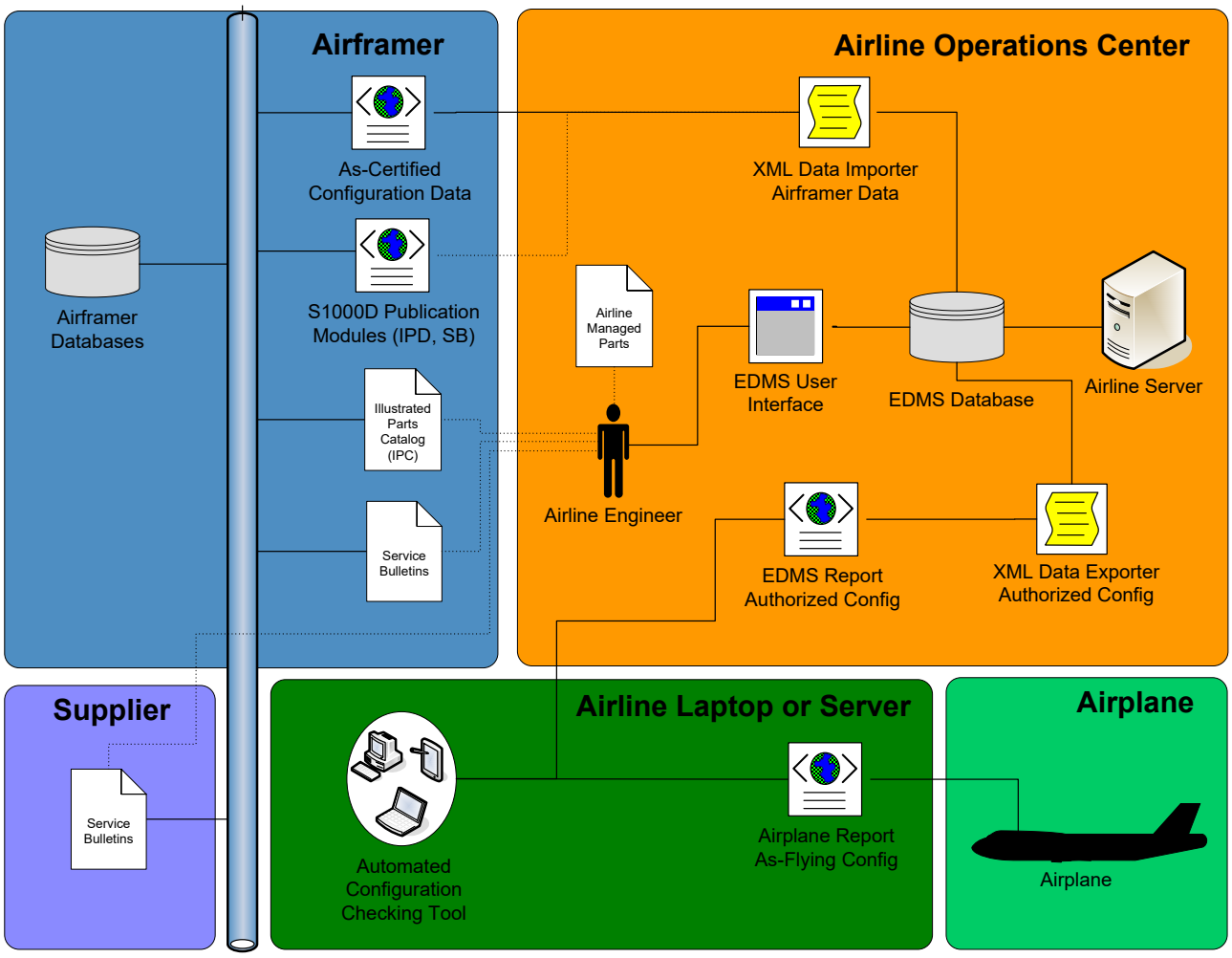


Figure A-1 – Airline EDMS System Architecture

A-2 EDMS Use of Certified Configuration Authority

The EDMS should the capability of importing CCA data since CCA data forms the basis of the ACR and changes to the CCA must be used to modify the ACR. XML CCA data may be imported automatically. Paper-based CCA data will require a manual input capability.

A-3 EDMS - Airline Configuration Reference

The primary function of an EDMS is to generate and manage the ACR for each aircraft in the operator's fleet.

ACR data may be utilized as a paper document or electronic file extracted from the airline's EDMS. When an automated configuration verification is desired, the extracted electronic file should utilize XML. ACR data extracted from an EDMS is expected to serve as the means by which the aircraft can be signed out, provided the data extracted and used is authorized for this purpose. An example of a document produced by the EDMS in support of an airline business process would be an EO used to authorize software installations. The EDMS should also be expected to produce authorized configuration reports for each aircraft in an airline's fleet in support of aircraft software configuration verification processes.

APPENDIX A
EDMS CONCEPT

Note that airlines have expressed the desire for a loadable software configuration control and distribution system that is not limited by the frequency of the software updates. Some unique loadable software configuration changes occur very frequently and in some cases, may also require that the configuration change be expedited. To this end, these certain changes may not adhere to the standard configuration and distribution systems of other loadable software configuration changes. While the system may not be the same, the airline is required to maintain configuration integrity on the aircraft.

A-4 EDMS – Software Configuration Elements

The following information should be considered for inclusion in the airline's EDMS ACR for managing each ACLSP:

- Software (ACLSP) Part Number
- Software (ACLSP) Part Nomenclature
- SLID (If used)
- SLID Nomenclature (If used)
- FIN (If used)
- FIN Nomenclature (If used)
- Target Hardware
- Software versioning information (if used)
- Aircraft IDs (i.e., identification of aircraft where the part is installed)
- Aircraft Model
- Media Set Part Number (if used)
- Load tools or load process to be used
- Compatibility, Interchangability, and Intermixability data
- Engineering Configuration Change Management Data (described in Section 8.1.1)
- Configuration State Management Data

A-4.1 EDMS – Configuration Change Management

EDMS should track changes to the ACR and the generation of EOs to implement each software configuration change per Section 8.1.1 as well as track the state of configuration changes as described below:

A-4.2 Configuration State Management

As aircraft increase in software complexity, state management becomes more important to keeping control of the aircraft software configuration. There are three aspects to state management: work flow state management, authorization state management and SB processing. Each of these is discussed in the sections below.

A-4.2.1 Work Flow State Management

An airline may need to track the work flow state of a change incorporation throughout its life cycle. These states may be applied to an engineering change package and/or to individual ACLSPs. However, the airline's EDMS should manage these states to ensure the greatest degree of coordination and transition of tasks between various

airline engineering and maintenance personnel that are involved in the life cycle of a change.

The recommended states that should be tracked in an airline's EDMS for an ACLSP change are as follows (state names are notional):

- In-Work: Represents engineering change packages or parts that are in the airline's EDMS but not yet ready to go through the change approval process.
- Approved: Represents airline approval of an engineering change package or an individual part change that includes the part(s) to be installed as well as the part(s) to be replaced.
- Available: Represents that part(s) associated with an approved change are available to the airline and ready to be distributed to aircraft onboard MSDs.
- Distributed: Represents part(s) either electronically or on physical media associated with an approved change have been staged to the appropriate onboard MSD, portable data loader, or shop data loader in preparation for installation.
- Installed: Represents that part(s) associated with an approved change have been installed in the appropriate target hardware and are ready for use.

An airline may add other states as needed by their business process. Examples are: Rejected (for change packages that are refused), Verified (indicates aircraft-level verification has been performed on an MSD or the aircraft installed configuration and has been verified to match the airlines authorized configuration).

A-4.2.2 Authorization State Management

The complexity of transitioning from an existing ACLSP to a new one requires a method of controlling which parts are authorized to be installed in a particular aircraft at any point in time. In addition, information may be desired to be conveyed to a mechanic regarding which ACLSP(s) might be preferred or allowed in a particular situation. Some airlines may not provide choices to line maintenance in their ACR. Authorization states may be for Engineering only or could be made available to line maintenance in the EDMS depending on airline preference.

Authorization states should only be applied to ACS that are Approved in the ACR for installation on one or more aircraft.

The recommended states that should be tracked in an airline's EDMS for each ACLSP for each aircraft are as follows (state names are notional):

- Required: Represents a part being officially approved for installation. It is recommended that when this state is used it means only one part number of the part type in question is approved for installation at the designated location. If more than one part is desired to be authorized, the "Preferred" and "Allowed" states should be used instead.
- Preferred: Represents a part being officially approved for installation and being the part number that is preferred to be installed when multiple choices are available.
- Allowed: Represents a part being officially approved for installation and being a part number that is not preferred to be installed when multiple choices are available.

- Superseded: Represents a part that was once officially approved for installation but has been superseded by newer parts, is no longer compatible with current hardware, or the approval was removed by Airworthiness Directive (AD).

It is important to note that multiple ACLSP numbers for the same part type and installation location may exist at any point in time, especially while performing state management during processing of a new ACLSP change to an aircraft as described in the next section. In those instances, it is recommended that rather than identifying multiple "Required" parts, one of the parts be identified as "Preferred" and the others as "Allowed."

A-4.2.3 State Management During Change Processing

As a change is processed, it is imperative that the change and state management processes come together to give an accurate accounting of parts authorized to exist on the aircraft in target hardware and onboard MSDs. One of the more important aspects to consider is how states are managed during the change events that lead from the CCA to the current change state in the ACR. The following is an example of how this occurs.

1. When a new change (either SB or AGC) comes in, a change package is created in the EDMS or equivalent that matches existing ACLSP numbers from SLID/FIN/part nomenclature (both installed and onboard MSD) identified in the change authority (SB or EO) to the new ACLSP numbers that will replace them.
2. Part instances must be created or imported (via S1000D) into the EDMS for the new part numbers. These instances must call out the installation location (SLID/FIN) and the change authority (SB #, AGC #, EO #, etc.).
3. The before change and after change states against the change authority (e.g., SB, EO, AGC, etc.) need to be represented in the existing and new part instances (e.g., Pre-SB #, Post-SB #, Pre-AGC #, Post-AGC #, Pre-EO #, Post-EO #, etc.).
4. Next, the authorization states need to be set for new parts as well as all existing parts currently assigned to the same SLID/FIN/part nomenclature in the "Required," "Preferred," or "Allowed" state. This can be a complex process, especially if new hardware parts are involved in the change and may also be dictated by specific airline procedures. Regardless, new parts need to be assigned to either the "Required," "Preferred," or "Allowed" state. Existing parts that are incompatible with new hardware or are to be removed by AD must be set to "Superseded" Authorization state.
5. The change package is approved giving all new part instances in the change package a state of "Approved."

COMMENTARY

While the change is in process, it is generally expected that the pre-change and post-change parts could independently be in either "Required," "Preferred," or "Allowed" state. An exception would be if hardware changes which would render existing software incompatible. In that case, more stringent control of the authorized configuration may be necessary.

6. Once a change package has been approved, the airline's electronic ACLSP vault is checked to see if the airline is in possession of all parts in the change

package. Parts that exist in the airline ACLSP vault should be given the state Available. Any parts not currently existing in the ACLSP vault must be ordered first. Once ordered parts are received and released into the airline ACLSP vault, they may be given the state of Available. Details of this process are provided in Section 4.0.

7. Once parts are available, they may be distributed to the installation point. When distribution is confirmed to be complete, the associated parts should be given the state Distributed. Details of this process are provided in Section 5.0.
8. Once parts are distributed, they are ready for installation. When installation is confirmed to be complete, the associated parts should be given the state Installed. Details of this process are provided in Section 9.0.
9. Once installation is verified and a confirmation sent back to airline engineering and recorded into the EDMS via the “Installed” state, authorization states may need to be adjusted again to reflect the new “Required” or “Preferred” parts. It is recommended that any replaced or previously installed parts that retain the “Required” or “Preferred” state be downgraded to “Allowed” or “Superseded” as necessary.
10. Once all authorization states have been moved to their final values per the change package a final aircraft-level verification is recommended. Once this verification is complete, it is recommended that the change package is closed to represent completion.

A-4.2.4 State Management During Component Replacement

The Authorization State of a particular ACLSP instance may be highly dependent upon the hardware that is installed at any point in time. If a particular hardware part fails and must be replaced with a different but interchangeable hardware part, it must be assured that a compatible software part is installed, for the new hardware, as allowed by the CCA. If the previously installed ACLSP number is not compatible with the new hardware part number, changes are required to the identified “Required,” “Preferred,” and/or “Allowed” ACLSPs identified in the ACR.

For an component replacement of a different HW part number an airline may:

1. Provide choices of compatible HW and SW in their ACR
2. Require the mechanic to get Engineering approval of the HW-SW combination
3. Allow the mechanic to consult the CCA directly to ensure compatibility

If an update of multiple new HW and SW parts is installed, it is highly recommended that an aircraft-level verification be performed to confirm that the aircraft is once again in compliance with the ACR.

APPENDIX B GLOSSARY

Aircraft Configuration Report

Configuration report extracted from the aircraft as source data to the configuration checking function.

Airborne Data Loader – ADL

ADL is airborne data loading equipment that usually includes a media source (e.g., 3.5-inch floppy disc drive, CD-ROM, MSD, etc.). It is installed on the aircraft to facilitate the loading of data and operational software programs to onboard computers.

Aircraft Maintenance Manual – AMM

The Aircraft Maintenance Manual contains instructions used by maintenance personnel on how to perform maintenance on-aircraft systems and equipment for continued airworthiness.

Airline Modifiable Information – AMI

Software Loads generated by the airlines to customize system operations. This ACLSP is a data file used by some systems to provide information used by the Operation Program Software (OPS).

As-Certified Configuration

The condition of the aircraft at Type Certification (prior to courtesy load) with regards to the FAA Part 25 hardware and software installed on the aircraft.

As-Flying Configuration

The condition of the aircraft in service with regards to the hardware and software installed on the aircraft. This is the configuration as reported by the aircraft.

Authentication

Authentication is a technique used to prove that the sender of data is who that party claims to be.

Authorized Configuration

A list of aircraft and components with ACLSP that is applicable to that aircraft. This list should originate from an ACR. It must be easily accessible by quality assurance engineering, certification authorities, and maintenance personnel that need to validate and install ACLSP.

Certificate of Conformity

A software Certificate of Conformity (CoC) is a document that is included during the transfer of airborne software types that do not require a regulatory document such as an FAA Form 8130-3 or EASA Form One. In such cases, the CoC can be used instead of the regulatory documentation.

Component Maintenance Manual – CMM

The Component Maintenance Manual is a shop manual prepared in accordance with ATA spec100/ATA ispec 2200. The CMM provides the technical data to restore shop

repairable components to a serviceable condition that includes to loading of software if applicable.

Configuration Management

The process of recording, evaluating, approving or disapproving, and coordinating changes to configuration items after formal establishment of their configuration identification or to baselines after their establishment.

The systematic evaluation, coordination, approval or disapproval and implementation of approved changes in the configuration of a configuration item after formal establishment of its configuration identification or to based lines after their establishment. Synonymous with Configuration Control.

Configuration Verification

Configuration verification is the act of comparing the authorized aircraft software configuration to the actual aircraft configuration to ensure that the correct software is installed.

Copy

Reproduction of files to create a duplicate new software image.

Copy Process

The airline approved process that ensures that the airlines abide by rules outlined in vendor contract to make and distribute copies of software.

Copyright

The legal term used which applies total rights to the creation, modification, use, manufacturing, reproduction, sales, and distribution of software. A legal term that should not be confused with the term rights to copy.

Courtesy Load

The software loaded by the airframe manufacturer following Type Certification for the airline as requested, after transfer of title to the aircraft.

Criticality

Criticality is a measure of the severity of loss that results from failure. FAR Part 25.1309 provides definitions of critical and catastrophic.

Criticality Level

Classifications assigned to aircraft software for system safety assessment.

Level A (Catastrophic) thru Level E (No Effect).

Cross Load or Crossload

The act or ability to load software to a hardware unit from an already loaded hardware unit.

APPENDIX B
GLOSSARY

Cyclic Redundancy Check – CRC

A value calculated from a block of data used to detect unintended changes. CRC algorithms are chosen so that changes in the block of data are very likely to change the calculated value of the CRC value.

Database

A systematic organization of data, which facilitates access, retrieval and update.

Data File

A specific file that contains, in addition to other information, the actual data that is the object of the load process.

Data Loader (Software Loader)

Equipment (hardware and software) used to load software to aircraft hardware.

Data Loading

See Software Loading.

Download (Down Load)

Transfer of data from aircraft hardware to a source (software loader, transport media, etc.).

Duplication

See Copy definition.

e-Enabled Aircraft

Aircraft that support electronic distribution of data and software to and from ground systems.

Electronic Distribution of Software – EDS

Processes whereby airplane loadable software is moved from a supplier or repository to a remote user site without physical media (wired or wireless). See ARINC Report 827.

Electro Static Discharge – ESD

ESD is the transfer of charge between bodies at different electrical potentials.

Fault Isolation Manual – FIM

The Fault Isolation Manual provides maintenance personnel with fault isolation information and corrective action. See also Troubleshooting Manual.

Field Loadable Software – FLS

The term FLS is considered equivalent to ACLSP and ACS in ARINC software standards. FAA 8110.49 defines FLS from a regulatory point of view.

Functional Item Number

A FIN identifies an item performing a function within a system. A FIN is unique for the whole Aircraft.

APPENDIX B
GLOSSARY

Hardware

Physical equipment. Contrast with software.

Header File

A file that contains information about the load that is needed to support the load process and software handling processes. Each load has one header file.

Installation Verification

Verification that is performed as part of the data load activity per instructions in the AMM, CMM, and/or installation Work Order.

Integrated Modular Avionics

Avionics integrated into cabinets using common backplanes for power, ground, and signal paths. Often consists of circuit card assemblies that are easily changed or reprogrammed.

Line Replaceable Unit – LRU

A component, which is designed to be removed and replaced by line maintenance personnel.

Load (noun)

Synonym for “Loadable Software” and “Software Load” and “ACLSP.” Generally, this term should not be used in favor of ACLSP.

Load (verb)

The process of transferring data into the memory of the target hardware.

Load Part Number – Load P/N

The P/N of the Loadable Software Part (not the P/N of media set on which the software load is located).

Loadable Software

A software data set (i.e., group of files) designed for transferring into its “target hardware” without physically altering the hardware.

Load Site

The position, place or memory location in the target hardware designed to contain software.

Load Source

The source of the data and header files that are being loaded.

Load Verification

See Installation Verification.

Navigational Database - NDB

A read-only data base of navigational information for upload to the Flight Management Computer (FMC).

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Mass-Storage Device – MSD

A large capacity nonvolatile storage medium for software or data entities. Example: A hard disc drive or CD-ROM.

Media

Devices or material, which acts as a means of transferring or storage of software (e.g., programmable read-only memory, magnetic tapes or discs).

Maintenance, Repair and Overhaul – MRO

A company or organization that the airline designates to perform maintenance, repair and overhaul services on their aircraft.

Onboard Server

Mass storage device located on the aircraft that may be loaded with ACS for eventual installation into the airplane systems.

Onboard Load

Transfer of loadable software into target hardware while the hardware is installed on the aircraft.

Operational Program Software – OPS

This ACLSP is the program instruction for the target hardware.

Operational

Able to or performing its intended normal mission functions.

Operational Program Configuration – OPC

A load which contains information to control/select the flow/functionality of the OPS. This load replaces (or supplements) hardware program pin functions and may contain OPS option selections, installed equipment complement, aircraft structural configuration, engine type or other information that the OPS needs to know to properly operate in the specific environment. OPCs are generally very small and aircraft or customer specific.

This ACLSP is a special purpose database used to determine the function of the target hardware. The OPC is small compared to the Operational Program Software OPS.

Operational Program Software – OPS

A load, which contains application software for the target hardware. This ACLSP is the program instructions for the target hardware. Each version of the OPS has a unique software part number.

Original Equipment Manufacturer – OEM

This term generally refers to aircraft manufacturer. However, in this document it can describe an equipment manufacturer of a component. Also, the term OEM can be used interchangeably with the following terms: vendor, equipment supplier, software supplier, software provider, or aircraft manufacturer.

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Option Selectable Software (OSS)

Option Selectable Software is ACLSP that the operator can modify within some boundaries without re-certification. The system design should protect against inadvertent selections involving unsafe configurations for the target (host) computer.

Part Number

A set of numbers, letters or other characters used to identify a configuration item.

PC Card

PC Card is the term used for PCMCIA (Personal Computer Memory Card International Association) Cards. These cards are used as Mass Storage Media Devices on an Aircraft or components. They are used to load programs and download data.

Portable Data Loader – PDL

A portable tool able to perform loading of software on the aircraft.

Portable Document Format – PDF

Portable Document Format is an open de facto standard for electronic document distribution. Adobe® PDF is a file format that preserves all the fonts, formatting, graphics, and color of any source document, regardless of the application and platform used to create it. Adobe® PDF files are compact and can be shared, viewed, navigated, and printed exactly as intended.

Pre-Load (Preload)

The shop load of the ACS into the same hardware it would reside in if the software were installed on the aircraft.

Process

A collection of ordered activities performed to produce a definable output or product.

Production Part

A production-configured hardware or software part intended for delivery.

Program Memory

The nonvolatile memory that the load is intended to remain in when the target hardware is not in software load mode. Program memory does not include any buffer memory that data may reside in during data transfer.

Protocol

A formalized set of rules by which computers communicate.

Reproduction

This term describes the action of creating an exact replica of the software by creating it from a software tool. The tool may be the original tool that created or it might be a certified replica of the tool with the exact instruction set to create and compile the software onto a media.

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Rights to Copy

The term used which applies rights to a purchasing airline to make duplications/reproductions of software for the sole purpose of loading target aircraft components and/or systems. It does not grant rights to modification, sales, or distribution of that software outside the boundaries of the airline. The vender must grant Rights to Copy via a contract in order for the airline to make copies.

Safety

Safety is preventing loss due to failure. Not synonymous with security.

Security

Security is preventing loss due to deliberate actions. These actions include access to data by parties that do not have privilege to access the data. This type of security is covered by access control, violation control, or data privacy.

Shop Load (Bench Load)

The transfer of loadable software into target hardware while the hardware is not installed on the aircraft.

Software

Data or code (executable or not) that defines controls or is used by its target hardware to perform its function.

Software Control Library – SCL

An administrative organization designed to store, distribute, and manage LSPs.

Software Installation

The process of Software loading and software configuration verification to ascertain the correct software is in the correct target hardware and location. Successful loading to target hardware = software load + software configuration verification.

Software Load (noun)

Synonym for loadable software.

Software Load Part Number

Synonym for load part number.

Software Loading

Process of uploading software (including data) to the target hardware.

Software Part Number

Synonym for load part number.

Supplemental Type Certificate – STC

A Supplemental Type Certificate is issued for major design change to type-certificated products when the change is not so extensive as to require a new TC. For more information, reference FAR Part 21.463.

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System

A group of components united by interaction or interdependence, performing various tasks but functioning as an integrated whole.

Target Hardware

The subject hardware of an operation. For example: the destination of the load, the hardware/component/location selected by the maintenance person as the destination of the load, the hardware the software is designed to operate in, etc.

Target Hardware = TH = LRU = Unit

Target Hardware defines the hardware such as a component or Module that is intended to be loaded with a different LSP.

Target Hardware ID

See ARINC Report 665.

Terrain Database

This ACS is used by the Enhanced Ground Proximity Warning System (EGPWS) or by other ground proximity systems, which map the terrain around an aircraft during flight.

Transfer

The action by which software or data is moved from one media to another.

Troubleshooting Manual – TSM

Manual enabling the systematic identification, isolation, and correction of aircraft warning and malfunctions reported in flight and on the ground. See also Fault Isolation Manual.

Type Certification – TC

A Type Certificate is considered to include the type design, the operating limitations, and the certificate data sheet, that comply with the applicable regulations of FAR Part 21.41 with which the Administrator records compliance, and any other conditions or limitations prescribed for the product in FAR Part 21.41.

Upload (Up Load)

The process of transferring data into the memory of the target hardware. This term describes the action of putting software into a target component or aircraft system.

User Certifiable Software – UCS

When this software is modified, it must be reviewed and approved by the appropriate Airworthiness Certification Office.

User Modifiable Software – UMS

This is software that is intended for modification by the aircraft operator (airline) without review by the certification authorities, the airframe manufacturer, or the equipment vendor. A tool is usually provided so the software can only be modified within given boundaries.

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Virus

A piece of software that installs itself on a computer system, can replicate itself, and attach to multiple executable software, and which may have a damaging effect on the computer system.

APPENDIX C ACRONYM LIST

ACR	Airline Configuration Reference
ACLSP	Aircraft Controlled Loadable Software Part
ACS	Aircraft Controlled Software
ADB	Aeronautical Database
ADL	Airborne Data Loader
AGC	Airline Generated Change
AMM	Aircraft Maintenance Manual
AMS	Airline Modifiable Software
ASD	Aircraft Support Data
ATE	Automatic Test Equipment
BFE	Buyer Furnished Equipment
CCA	Certified Configuration Authority
CD-ROM	Compact Disc-Read Only Memory
CMM	Component Maintenance Manual
COTS	Commercial Off-The-Shelf
CRC	Cyclic Redundancy Check
C of C	Certificate of Conformance
DB	Database
DVD	Digital Versatile Disc
EDS	Electronic Distribution of Software
EDMS	Electronic Data Management System
EFB	Electronic Flight Bag
EO	Engineering Order
ESD	Electrostatic Discharge
FAA	Federal Aviation Administration
FAR	Federal Airworthiness Requirement (FAA)
FIM	Fault Isolation Manual
FLS	Field Loadable Software
FMC	Flight Management Computer
FMS	Flight Management System
FOS	Flight Operations Software
HCLSP	Hardware Controlled Loadable Software Part
HCS	Hardware Controlled Software
ICA	Instructions for Continuing Airworthiness
IFE	In-Flight Entertainment
IMA	Integrated Modular Avionics
IPC	Illustrated Parts Catalog
IPD	Illustrated Parts Database
LRM	Line Replaceable Module

APPENDIX C
ACRONYM LIST

LRU	Line Replaceable Unit
LSAP	Loadable Software Aircraft Part
LSP	Loadable Software Part
MAT	Maintenance Access Terminal
MOS	Maintenance Operations Software
MRO	Maintenance, Repair, and Overhaul
MSD	Mass Storage Device
MSP	Media Set Part
NDB	Navigation Database
OALT	Off-Aircraft Loading Tool
OEM	Original Equipment Manufacturer
OPC	Operational Program Configuration
OPS	Operational Program Software
OSS	Option Selectable Software
PCMCIA	Personal Computer Memory Card International Association Card
PDL	Portable Data Loader
PMA	Parts Manufacturing Approval
PMAT	Portable Maintenance Access Terminal
P/N	Part Number
PROM	Programmable Read-Only Memory
SATCOM	Satellite Communication
SB	Service Bulletin
SCL	Software Control Library
SCS	Supplier Controlled Software
SFE	Seller Furnished Equipment
SLID	Software Location Identifier
SPE	Supplier Purchased Equipment
STC	Supplemental Type Certificate
SW	Software
TC	Type Certificate
TSM	Troubleshooting Manual
UCS	User Certifiable Software
UMS	User Modifiable Software
WO	Work Order
XML	Extensible Markup Language