

# ARINC IA Project Initiation/Modification (APIM)

- 1.0 Name of Proposed Project** **APIM #: 07-011A**  
GPS Landing System Sensor Unit (GLSSU) Definition
- 2.0 Subcommittee Assignment and Project Support**
- 2.1 Identify AEEC Group  
GLS/XLS working group or similar group consisting of those who developed ARINC Characteristic 743.
- 2.2 Support for the activity  
Airlines: Several airlines have been approached  
Airframe Manufacturers: Several have been approached and are aware of a new GLSSU receiver that integrates GPS precision approach with existing ARINC 710 ILS receivers and instruments.  
Suppliers: one major avionics supplier has been approached and is favorable to adopting the new avionics.  
Others:
- 2.3 Commitment for resources (Identify each company by name.)  
Airlines: Suggest FedEx may be interested  
Airframe Manufacturers: Suggest Airbus and Boeing may be interested  
Suppliers: Thales and Gables Engineering may be interested.  
Others:
- 2.4 Chairman: Suggest CMC Electronics (Daniel Domey or John Studenny)
- 2.5 Recommended Coordination with other groups  
XLS Committee (ARINC 755), SAI Subcommittee
- 3.0 Project Scope** (why and when standard is needed)
- 3.1 Description  
(Insert description of the scope of the project. Use the following symbol to check yes or no below. ☒)
- 3.2 Planned usage of the envisioned specification  
New aircraft developments planned to use this specification      yes  no   
    Airbus:                      (aircraft & date)  
    Boeing:                      (aircraft & date)  
    Other:                      (manufacturer, aircraft & date)  
Modification/retrofit requirement    yes  no

Specify: (aircraft & date)

Needed for airframe manufacturer or airline project      yes  no

Specify: (aircraft & date)

Mandate/regulatory requirement      yes  no

Program and date: (program & date)

Is the activity defining/changing an infrastructure standard?      yes  no

Specify (e.g., ARINC 429)

When is the ARINC standard required?  
 \_\_\_\_\_(month/year)\_\_\_\_\_

What is driving this date? \_\_\_\_\_(state reason)\_\_\_\_\_

Are 18 months (min) available for standardization work?      yes  no

If NO please specify solution: \_\_\_\_\_

Are Patent(s) involved?      yes  no

If YES please describe, identify patent holder: \_\_\_\_\_

### 3.3 Issues to be worked

The intention is to preserve the GNSSU existing architecture for both the 2 MCU and “alternate form-factor” (AFF) receiver architecture. It is recognized that these architectures support GPS navigation function but do not deal with GPS precision approach. This aspect was left to ARINC 755 and ARINC 756 for digital and analog aircraft respectively.

The ARINC 743 alternate form factor description needs to be re-defined to allow inclusion of LPV and GLS while preserving the legacy interface. However, with SBAS augmentation, the GNSS receiver will become a Primary Means of Navigation sensor. This has impact on how GPS can be used.

CMC Electronics recognizes the need for complete backward compatibility. However, the capability to incorporate GPS precision approach, derive utility from the use of both SBAS and GBAS, use of Primary Means Navigation, SA-OFF, integrating with ADS-B require new capability. CMC has developed an architecture that preserves the current architecture and interface, but that adds these new capabilities to the alternate form factor receiver. CMC does not build the 2 MCU receiver, but can and will provide assistance to modernize the 2 MCU receiver architecture. If this cannot be done, then the alternate form factor can be updated as per CMC's recommendations.

It is stressed that the focus will be on the augmentation of the alternate form factor GNSSU and GLSSU. The GLSSU is an entity that is independent of any interaction with an ARINC 755 MMR or an ARINC 756 MMR. In fact, the ARINC 755 and GLSSU may actual become competitive solutions.

## 4.0 Benefits

### 4.1 Basic benefits

Operational enhancements yes  no

For equipment standards:

a. Is this a hardware characteristic? yes  no

b. Is this a software characteristic? yes  no

c. Interchangeable interface definition? yes  no

d. Interchangeable function definition? yes  no

If not fully interchangeable, please explain: \_\_\_\_\_

Is this a software interface and protocol standard? yes  no

Specify: ARINC 429\_\_\_\_\_

Product offered by more than one supplier yes  no

Identify: \_\_\_\_\_ (company name)

### 4.2 Specific project benefits

First, ARINC Characteristic 743 needs to be updated to account for recent developments in our industry:

- a. How to cope with integrating with ADS-B. Note that GPS receiver guidance on this subject has been provided by RTCA/DO-229D. The data concerns velocity and the velocity figure of merit. These data require definition of new data labels.
- b. New RFI mask and receiver performance under such conditions. Again, RTCA/DO-229D sets the standards and corresponding receiver tests.
- c. Antenna consideration. In view of the new RFI mask, TSO C-190, specifically directed at antennae has been produced in response to RTCA/DO-301. Such an antenna is required for new SBAS and GBAS receivers.
- d. The current ARINC 743 does account for Primary Means of Navigation as provided by a SBAS/GBAS receiver. Such new receivers can provide RNP0.1 navigation with an availability >99.999% when in SBAS or GBAS coverage.
- e. RTCA/DO-229D provides the certification basis for SA-OFF (when not in SBAS coverage). The impact is far better RNP performance/availability.
- f. The environmental test standard is RTCA/DO-160E.

Second, ARINC Characteristic 743 needs to be updated to provide a new GPS receiver architecture that provides GPS (or GNSS) Precision Approach capability (and integration) with existing ILS receivers, instruments, autopilots, and FMS. This is intended as an alternative to an all-in-one MMR solution that preserves existing avionics without causing major architecture or equipment change to an existing aircraft with existing ILS, autopilot, or FMS.

The benefits of this receiver/architecture are:

- a. The Global Landing System Sensor Unit, or GLSSU, allows for “drop-in” GPS Precision Approach integration with existing ILS, instruments, autopilot, and FMS architectures, wiring, and certifications. It is intended to cause at most, minor modifications and preserve the existing avionics (intact) and aircraft certification(s).
- b. Regardless of the GNSS satellites, CMC’s proposed architecture with respect to the aircraft will not change. The sensor unit might change, but only the GNSS sensor. No other avionics or wiring would change. This is an important aspect for consideration because Galileo will become a part of GNSS at the very least. CMC intends to produce combined GPS/Galileo receivers in the alternate form factor.

#### 4.2.1 Benefits for Airlines

The GLSSU provides several major benefits for a great many existing aircraft, including those that have an ILS-only MMR:

- a. Primary Means of Navigation. GPS navigation availability would be better than RNP0.1 with an availability of >99.999% when in either SBAS and/or GBAS coverage. When not covered by SBAS or GBAS, the reversionary mode is SA-OFF. SA-OFF provides a much improved availability to current TSO C-129a GPS receivers. However, the certification basis for SA-OFF is RTCA/DO-229D. Please note that RTCA/DO-229D is the first SA-OFF MOPS in our industry. This will be provided on the current connector and data WITHOUT change to the existing interface. The major impact is that predictive would no longer be required; however, to maintain compatibility with existing FMS, that capability will be retained as specified in the current interface. However, credit for SA-OFF would be taken.
- b. GPS Precision Approach. The GLSSU architecture supports the “bolting-on” of GPS Precision Approach, both SBAS and GBAS. In cases where ground infrastructure is unavailable, SBAS can provide LPV approach, which useful for “black-hole” approaches. In the case where GBAS is installed, the GLSSU can provide GLS approaches. For either SBAS or GBAS approaches, it is the pilot who makes the choice, the GLSSU obeys the selection.
- c. The GLSSU contains a “High Integrity Switch” and outputs GLSSU derived Localizer and Glide Slope (in ARINC 710, analog, can CSDB interfaces). The intent is that GPS precision approach is added to the aircraft without forcing a change out of the existing ILS or instruments. Since LOC and GS are output, there is no impact on the autopilot or its control laws, or approach instrumentation. The pilot selects either GPS approaches (either SBAS or GBAS) or ILS approaches. The built-in High Integrity Switch allows for selection between ILS and GPS approaches. As above, the pilot selects the type of approach, the GLSSU obeys the pilot’s command.
- d. The GLSSU has been designed so that it can host the SBAS approach database. This capability may be required if it is not possible for the FMS to host the SBAS database. In such a case, the GLSSU can independently host 2 cycles of the entire world-wide database.
- e. Avionics and capability support. The GLSSU will support ADS-B with velocity and velocity figure-of-merit. The latter is a new capability and its data needs definition. As TAWS evolve, the vertical data from the GLSSU (because its

certification basis is SBAS) can provide much better vertical information with integrity exceeding 99.999% availability (SBAS must support LPV approach at all times, therefore the resulting vertical data will have high accuracy and integrity at all times).

- f. The GLSSU is a low cost alternative to the MMR architecture that is backward compatible with the GNSSU architecture. This consideration is indeed the case with retrofits (where a MMR has not been installed).

#### 4.2.2 Benefits for Airframe Manufacturers

The GLSSU will allow the airframe manufacturers to offer OEM installation of GPS Primary Means Navigation (SBAS, GBAS, or SA-OFF) and GPS Precision Approach (either SBAS or GBAS) to aircraft that do not have such a capability. In addition, the GLSSU supports ADS-B according to RTCA/DO-229D. Any TAWS system may derive benefit as well.

CMC desires to make the GLSSU an open standard in support of Airframe Manufacturers as well as avionics manufacturers.

#### 4.2.3 Benefits for Avionics Equipment Suppliers

As mentioned above, the GLSSU supports ADS-B and TAWS avionics and capabilities. CMC desires that the GLSSUs architecture be open to the industry so the GLSSU can be integrated with as many other avionics as possible.

Most importantly, the GLSSU is a low cost unit intended to “bolt-on” to the aircraft and integrate with other avionics. CMC has developed the GLSSU so that impact on other avionics (particularly the FMS) is minimal. CMC specifically designed the GLSSU to keep fly-away costs minimal (compared to other GPS solutions).

## 5.0 Documents to be Produced and Date of Expected Result

### 5.1 Meetings and Expected Document Completion

The following table identifies the number of meetings and proposed meeting days needed to produce the documents described above.

Activity	Mtgs	Mtg-Days (Total)	Expected Start Date	Expected Completion Date
New ARINC 743B	4-5 web conf & face-to-face	1 to 2 days/meeting	Dec/2007	Dec/2008
Supp 5 to ARINC 743A	(see above)	(see above)	Dec/2007	Dec/2008

*\* Indicate unsupported meetings and meeting days, i.e., technical working group or other ad hoc meetings that do not requiring IA staff support.*

## 6.0 Comments

CMC has developed a GLSSU sensor, with the FAA’s support, specifically to retrofit existing aircraft with GPS Precision Approach capability. This project concerns itself with extending ARINC 743 to accommodate a new definition for a GPS Landing System Sensor Unit (GLSSU) for the “alternate form factor”. The weakness in the current definition of the ARINC 743 alternate form factor is that it

does not address the benefits provided by either SBAS or GBAS.

In addition, the GLSSU was developed to minimize the fly-away cost for retrofit programs. CMC and the FAA are very sensitive to the fact that fly-away cost is the single factor that determines whether a program launches or not. The GLSSU was developed so that SBAS and GBAS will be affordable for retrofit aircraft.

The main objectives of this work plan are:

1. Update the alternate form factor definition to include LPV and GLS functionality.
2. The update will be such that the impact on existing aircraft or its avionics is minimal.
3. The update will preserve the legacy navigation connector and its interfaces to ensure backward compatibility of the alternate form factor definition. Backwards compatibility with legacy systems will be maintained.
4. The update will propose a new precision approach connector that will define the LPV and GLS interfaces. With respect to the existing alternate form factor definition, the proposed work project will augment, not change, the existing alternate form factor connectors and the corresponding electronic and data interface.

The work plan is as follows:

1. Update WAAS/SBAS functionality for the ARINC 743 alternate form factor and include the latest aspects from RTCA/DO-229D and TSO-C145b Beta-1/2/3 and TSO-C146b Delta-4 functionality. This includes FAS database as well, RTCA/DO-200A and ARINC-424
2. Update LAAS/GBAS functionality for the ARINC 743 alternate form factor and include the latest aspects from RTCA/DO-253B and TSO C-161b.
3. Update GRAS functionality for the ARINC 743 alternate form factor and include the latest aspects from RTCA/DO-TBD.
4. Update the antenna requirements for the ARINC 743 alternate form factor and include the latest aspects from RTCA/DO-301 and TSO C-190.
5. As above, but for ABAS, specifically for integration with Inertial Measurement/Navigation Systems, as described in RTCA/DO-229C.
6. Update the current alternate form factor connector definition for the enroute navigation interface with respect to RTCA/DO-229D & TSO-145b/146b and Primary Means Navigation.
7. Define a new precision approach connector for the alternate form factor specifically to address LPV and GLS functionality. The LPV/GLS functionality will produce "ILS look-a-like" signals for both digital and analog autopilot/flight director interfaces.
8. Define aircraft-level architecture(s) that allows minimal-impact integration of LPV/GLS with existing (retrofit) and future (forward fit) aircraft. The assumption is that these aircraft have open ARINC avionics systems that allow integration of LPV/GLS in a manner similar to integrating ILS to the aircraft.
9. Define aircraft-level architecture that allows upgrade of the GNSSU/GLSSU radio to accommodate new GNSS augmentations such as GALILEO while preserving

the aircraft interface.

10. Reuse as much of the ARINC 755 as possible so that compatibility between ARINC 755 and ARINC 743 is maximized.
11. Preserve the legacy ARINC 743 GNSSU alternate form factor definition.

#### Project Benefit:

CMC Electronics has fielded over 8000 ARINC 743 GNSSUs. Most of these units do not have GLS capability. CMC has had significant feedback from the customer base for an upgraded GNSSU capable of SBAS LPV/GLS and GBAS GLS that has minimal impact on existing aircraft. In particular, an alternative to MMR that maximizes existing aircraft equipage and certification is of interest. In response, CMC is developing LPV/GLS capability for a new alternate form factor ARINC 743 "GNSSU", referred to as the GLSSU.

CMC understands that bringing LPV/GLS and WAAS Primary Means Navigation to aircraft requires integration with existing and potentially future aircraft architectures. The approach being put forward emphasizes augmenting the existing aircraft architectures with a GLSSU system without any significant impact on the aircraft, or its existing avionics and certifications.

CMC believes it has developed an architecture for the GLSSU that meets these objectives and provides a low cost alternative to the all-encompassing MMR. In addition, the GLSSU may be added to aircraft that already have a MMR, but whose MMR does not have LPV or GLS functionality.

ARINC 743B benefits are expected to be as follows:

1. The Characteristic will provide a new standard for GPS Primary Means Navigation and GPS approach (both LPV and GLS) to which the airline customers can refer to for standard form, fit, and function equipment and a low cost alternative to the MMR.
2. The Characteristic will support ADS-B. Please note RTCA/DO-229D provides guidance with respect to ADS-B. Certification to SBAS and RTCA/DO-229D provides support to ADS-B.
3. The Characteristic will provide a new architecture that allows integration of LPV and GLS in a simple and cost-effective manner and be compatible with existing ILS installations.
4. The Characteristic will provide a new architecture that allows integration of LPV and GLS in a simple and cost-effective manner and be compatible with existing MMR installations.
5. The Characteristic will provide such information in an open and easily accessible forum for the entire industry.
6. The Characteristic will serve as a defacto open standard for integration of the GLSSU into aircraft.

An important aspect for consideration is GNSS infra-structure augmentations. The best known GNSS infra-structure augmentations are SBAS and GBAS. In

the near future, Galileo will also become a part of these GNSS augmentations. This project supports the development of GNSS avionics as separate LRUs, as in ARINC Characteristic 743, that can easily cope with such changes while having a minimal, or no impact on the aircraft architecture, in keeping costs low.

Finally, this project intends to support an open standard and an open means of integrating LPV and GLS into existing and future aircraft. The GLSSU is an alternative to “all-inclusive”, high cost, avionics racks/computers/LRUs, especially those with proprietary architectures and buses. Such “all-inclusive” avionics make it impossible to offer innovative, highly competitive avionics from equally, or more capable, suppliers.

#### Projects/programs supported by work

The Bombardier Global Express family will have SBAS augmented GNSSU/GLSSUs. The GLSSU has been selected by at least one airframe maker, others are in discussion.

#### Closing Comments

It is recommended that two documents be developed. Project Paper 743B would define a GNSS Sensor with GLS capability. ARINC 743A will retain GNSS Sensor functions and would be updated by Supplement 5.

#### ***For IA Staff use***

Date Received: March 2008      AEEC staff assigned: Martinec

Estimated Cost: \_\_\_\_\_

Potential impact: A/C\_\_\_

(**A. Safety**      **B. Regulatory**      **C. New aircraft/system**      **D. Other**)

Forward to committee(s) (AEEC, AMC, FSEMC): AEEC\_\_\_\_\_ Date Forwarded:4/15/2008

Committee resolution: 1\_\_\_\_\_

(**0 Withdrawn**      **1 Authorized**      **2 Deferred**      **3 More detail needed**      **4 Rejected**)

Assigned Priority:A\_\_\_\_\_ Date of Resolution:4/15/2008\_\_\_\_\_

(**A High - execute first**      **B Normal - may be deferred.**)

Assigned to SC/WG:GNSS\_\_\_\_\_