

EGNOS v3 DFMC

EGNOS Workshop 2024

March 14, 2024

Trade Compliance Classification and Marking

**This presentation does not contain any controlled technical data
under the ECL, EAR or ITAR**

Agenda

- Brief Introduction to CMC Electronics Inc.
- EGNOS v3 / DFMC: What is it?
- Benefits of EGNOS V3 / DFMC in the Aviation Ecosystem
- EGNOS v3 / DFMC Implementation in Aviation Receivers
- EGNOS and CMC : Success Stories



Introduction to CMC

Smart Avionics Simplifying Complex Missions

120
YEARS

800+
EMPLOYEES

3
SITES

10
PRODUCT PORTFOLIOS

150+
PLATFORMS

100+
CUSTOMERS

50+
COUNTRIES

For decades, CMC's avionics solutions have been leading the way to better safety, reliability, situational awareness and mission effectiveness in the aviation industry

Commercial and Defense Footprint

Platforms



OEMs



Worldwide Military & MODs



Airlines



CMC's Current SBAS Products

➤ CMA-3024 GNSSU

- TSO-C145 SBAS GPS receiver
- Fully ADS-B Out compliant
- Fielded MTBF \geq 650,000FH



CMA-3024 GNSSU

➤ CMA-5024 GLSSU

- All capabilities of CMA-3024, plus:
 - TSO-C146 for **LPV (equivalent to CAT-I)**
 - Certified up to DAL-A
 - Fielded MTBF \geq 650,000FH



CMA-5024 GLSSU

➤ CMA-6024 GLSSU

- All capabilities of CMA-5024, plus:
 - TSO-C161 & TSO-C162 for **GBAS GLS precision approaches**
 - Integrated VDB receiver built-in
 - Fielded MTBF \geq 170,000FH



CMA-6024 GLSSU

70,000+ CMC
GPS flying
today

EGNOS v3 / DFMC: What is it?

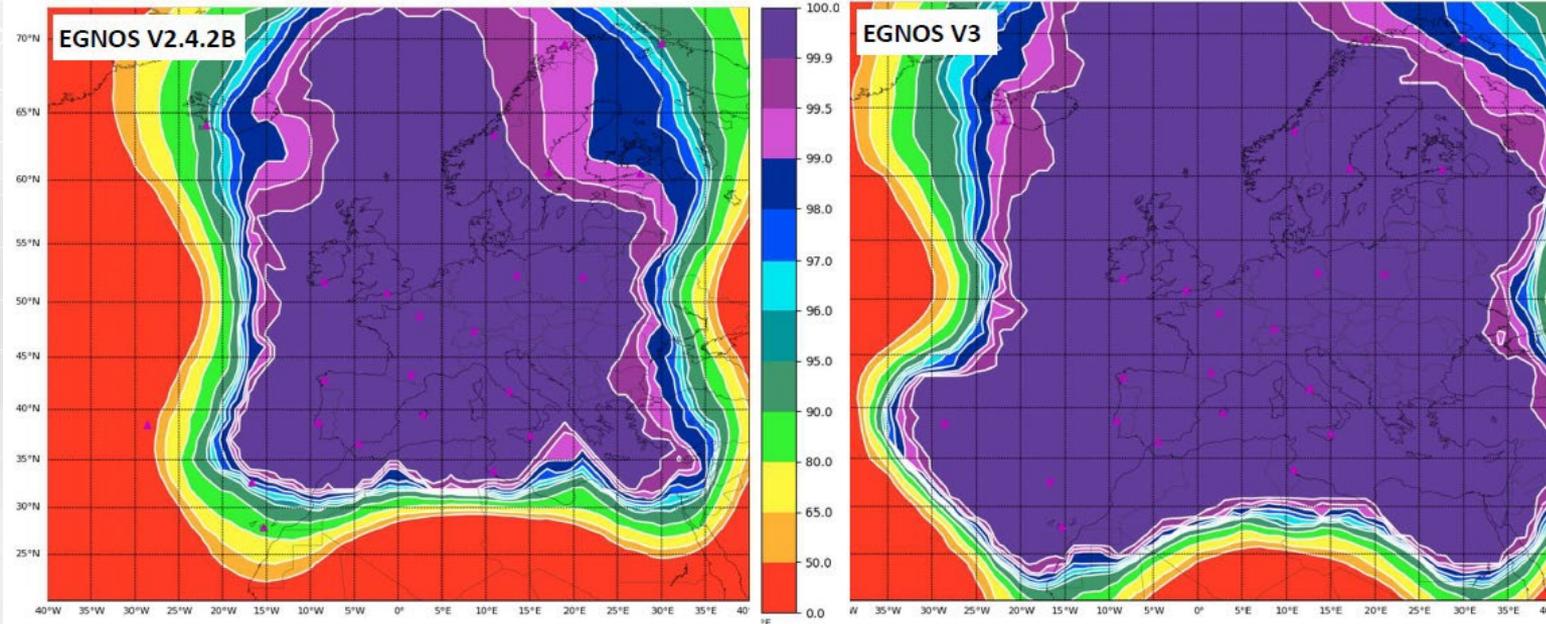
- EGNOS augments GNSS to improve the navigation performances in terms of accuracy and integrity over the European Civil Aviation Conference Region and to be expandable over neighbouring regions
- Current implementation of EGNOS (called EGNOS v2) only augments GPS Satellites via L1 signal
- The next generation of EGNOS (called EGNOS v3) is an improvement over EGNOS v2
- The main goal of EGNOS v3 is to provide:
 - Improved performance (mainly the accuracy and availability) on Safety of Life (SoL) services where people's lives are potentially at stake - mainly the Civil Aviation Community
 - New applications for maritime or land users
 - Improve the geographic coverage of the services provided by EGNOS
 - Improve robustness against increasing security risks, in particular cyber-security risks, such as spoofing

EGNOS v3 / DFMC: What is it?

- One of the main feature of EGNOS v3 is that it will also augment the Galileo GNSS constellation via L5, along with GPS L1: Dual Frequency, Multi Constellations (DFMC)
- EGNOS v3 services will be introduced in phases:
 - **EGNOS v3.1:** will ensure continuity of EGNOS augmentation of GPS L1, and enhanced performance under acute ionosphere conditions by using signal from both GPS and Galileo
 - **EGNOS v3.2:** will support a new SBAS service transmitting on the L5 frequency, hence augmenting GPS and Galileo constellations (DFMC)
- **Authentication of the SBAS message – enhanced robustness and resilience for cybersecurity**
- **Transition between EGNOS V2 and EGNOS V3 will be seamless, as the new system is being developed with backward compatibility**
- **Ground and Space infrastructures are upgraded to ensure smooth transition and activation of EGNOS v3**

EGNOS v3 / DFMC: Expected Performance

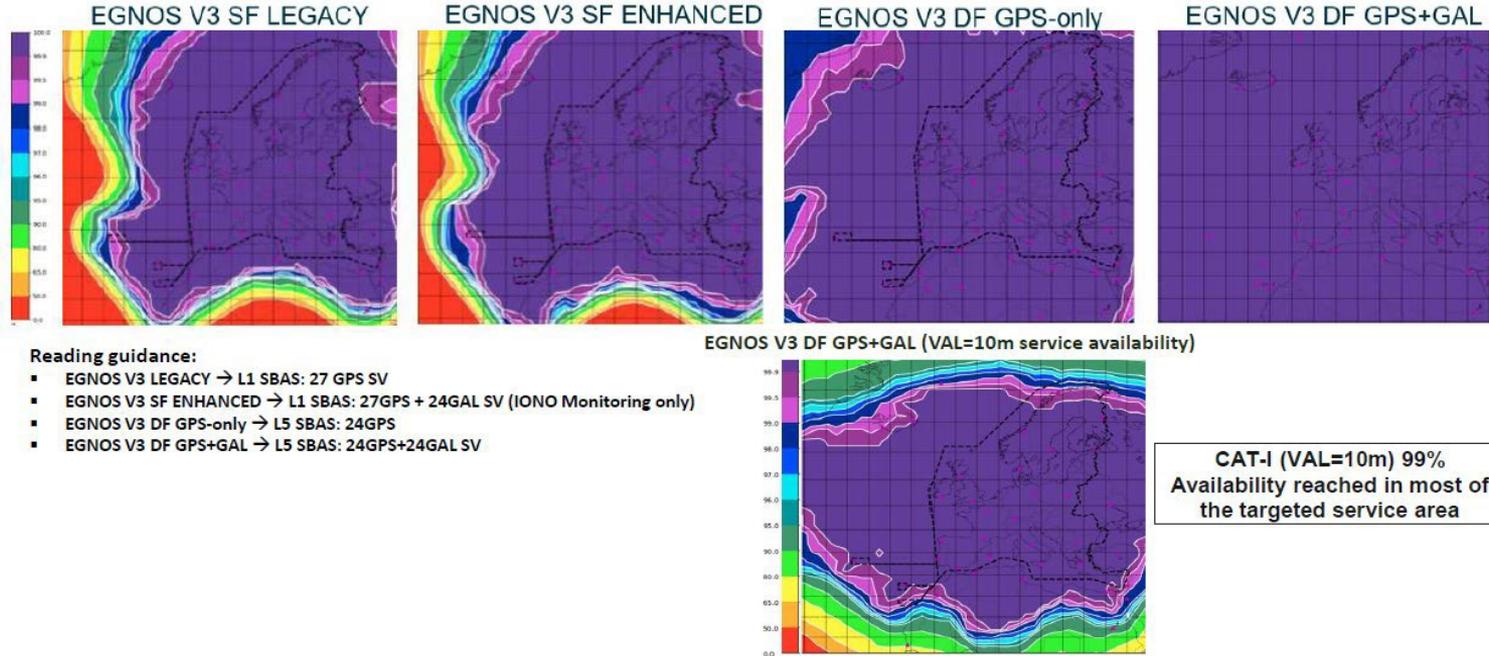
EGNOS L1 LPV-200 Availability February 2022
(Degraded Ionosphere)



Figures extracted from 2023 October EUROCAE WG-62 & RTCA WG-2/WG-4 joint meeting presentation. EUSPA proprietary, used with permission

EGNOS v3 / DFMC: Expected Performance

LPV-200 Availability under severe degraded ionosphere condition (synthetic scenario)



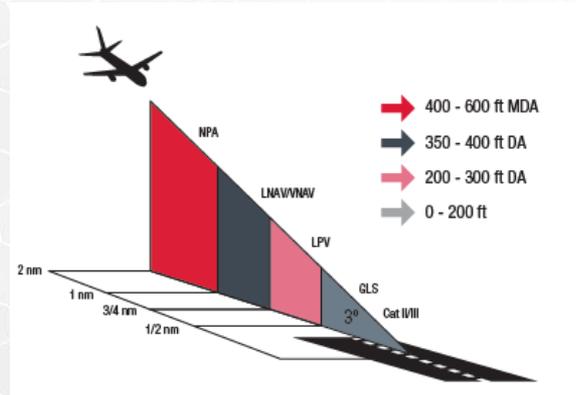
Figures extracted from 2023 October EUROCAE WG-62 & RTCA WG-2/WG-4 joint meeting presentation. EUSPA proprietary, used with permission

Benefits of EGNOS v3 in the Aviation Ecosystem

- Globally, EGNOS v3 is part of the European CNS/ATM roadmap, mandating the gradual implementation of Performance Based Navigation (PBN)
- As we have seen, EGNOS V3 is mainly tailored to provide augmented operational SoL services over Europe that improve the accuracy and availability of user positioning services from existing GNSS (Galileo and GPS) – SoL Services means mostly Civil Aviation
- One of the main objective of EGNOS SoL service is to support civil aviation operations down to Localiser Performance with Vertical Guidance (LPV), also known as Approach operations with Vertical Guidance (APV). More on that next!
- EGNOS v3.2 (via DFMC implementation) aims to ensure availability to 99.9%, required for LPV-200
- Extend GPS L1 Legacy services to the European Neighbourhood Policy South and East Territories (parts of North Africa, Near East and Eastern Europe)
- Authentication of the SBAS message – enhanced robustness and resilience for cybersecurity

EGNOS Aviation Benefit: LPV

- Localizer Performance with Vertical guidance (LPV) is an approach type similar to an instrument landing system (ILS) except that it relies on GPS with SBAS system instead of a ground infrastructure
- Using the computerized geometry of the approach, the system provides the lateral and vertical guidance all the way down to equivalent ILS CAT-I minimums

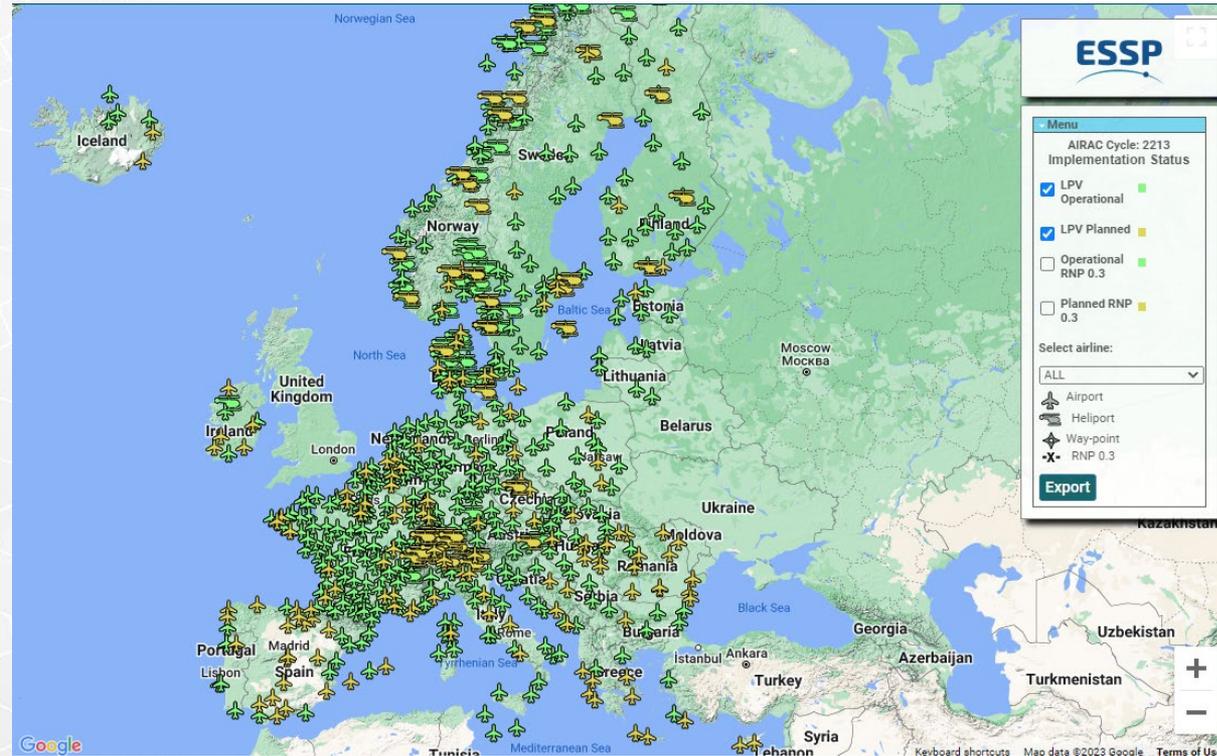


Benefits of LPV

- **LPV provides stable, near precision, instrument approach option when ILS is unavailable or not installed**
- **Best back up or alternate to ILS CAT I today, with down to 200ft minima**
 - Flexibility to setup an approach as far as 99nm from the airport
 - For example: in the USA, more than 60% of airports covered are non-ILS airports
- **LPV is expected to lead to:**
 - Reduced operating costs:
 - Reduced alternate fuel: closer alternate airports
 - Reduced track distance while setting for approach
 - Reduced Delays, Diversions and Cancellations (DDCs)
 - All the above also reduces the CO2 footprint
 - Increased safety
 - No intermediate step-down in the final approach vertical path
 - LPV glide path unaffected by temperature

Infrastructures – EGNOS Published LPV Approaches

- **Operational:**
 - 800+ LPV approaches
 - 400+ airports
- **Planned:**
 - 400+ LPV approaches
 - 200+ airports



Source: EGNOS User Support / ESSP website

EGNOS v3 / DFMC Implementation in Aviation Receivers

- Transition between EGNOS v2 and EGNOS v3 will be seamless, as the new system is being developed with backward compatibility
- Present-day aviation GNSS receivers that are EGNOS capable (TSO C145 / RTCA DO-229) will keep benefitting from enhanced performance via L1 signal under EGNOS v3
- To reap the full benefits of EGNOS v3 (with DFMC), the GNSS receiver must also be DFMC capable and certified
- The Minimum Operational Performance Standards (MOPS) for DFMC in Aviation are currently being defined (via EUROCAE and RTCA Working Groups)
- These MOPS will drive the performance and certification requirements of DFMC GNSS receivers for aviation – including implementation of EGNOS v3 DFMC

EGNOS v3 / DFMC Implementation in Aviation Receivers

- **CMC is actively involved in RTCA/EUROCAE Working Groups currently defining these MOPS**
- **In parallel, CMC is currently developing its Next Generation DFMC GNSS Receiver which will implement and fully enable GPS / Galileo / EGNOS v3 DFMC capabilities**
- **CMC's current GNSS receivers will keep benefitting from enhanced performance via L1 signal when transitioning to EGNOS v3 – seamless transition**
- **Conclusion: CMC is fully ready to embrace EGNOS v3 / DFMC in the future!**

EGNOS and CMC : Success Stories

CMC's LPV Solution Featured in EGNOS Bulletin

EGNOS

EGNOS BULLETIN
Issue 32, Spring'20 Edition

Credits: ASL Airlines



<https://egnos-user-support.essp-sas.eu/>



<https://www.essp-sas.eu/>

EGNOS BULLETIN | ISSUE 32 | SPRING'20 EDITION

World's First: B737NG successfully completes an LPV approach

Major achievements in Europe and across the pond, as the popular B737NG joins an ever growing list of aircraft that support SBAS navigation and LPV approach capability, all whilst meeting ADS-B Out mandates.



Credits: CMC Electronics

As airlines look to prolong the lifespan of their aging fleet, one Canadian company, CMC Electronics, offers a solution that keeps aircraft flying by meeting current worldwide ADS-B Out mandates and also takes advantage of the ever growing EGNOS infrastructure.

A historic moment
On a chilly day in October 2019 a B737NG successfully flew its first LPV approach into Kenai Municipal Airport (PAEN) in Alaska. The aircraft was equipped with CMC Electronics' CMA-5024 GLSSU which is fully compatible with EGNOS and supports SBAS navigation throughout all phases of flight.

The Federal Aviation Administration had just approved an STC certifying the installation of the CMA-5024 for the B737NG aircraft family (4500-700/800) for DO-260B ADS-B Out compliance and SBAS/GPS navigation with LPV approach capability.

It remains the first and only solution available today that is approved to introduce LPV approaches on a B737NG aircraft. This achievement was a collaborative effort between the FAA and CMC Electronics to make LPV a reality on one of the most popular air frames of all time, the B737NG.

European Approvals

Two EASA approvals are currently in progress. The first, approved by the FAA and TCCA and presented above, features the CMA-5024 as an SBAS positioning source for navigation and to meet worldwide ADS-B Out requirements in addition to supporting LPV approach capability. It is already approved by the FAA and TCCA. The second is a standalone ADS-B Out and LPV approach STC. EASA approvals for both solutions are well under way and expected within the current year.

Initial EGNOS Customers

There are currently two European customers that will be utilizing these B737NG solutions. The initial customer is an Italian airline offering scheduled and charter flights from Italy to various international destinations. Their installation will be for SBAS navigation and ADS-B Out only but provisioned for future growth to LPV. They appreciate the low cost solution that would allow their fleet to meet ADS-B Out mandates in the short term, while still providing the flexibility to take advantage of LPV approaches in the medium to long term. The next customer is ASL Airlines France, based in Paris-CDG they offer a full range of aviation

EGNOS BULLETIN | ISSUE 32 | SPRING'20 EDITION

services: scheduled, chartered and on-demand flights for passenger and freight activity. The airline operates a fleet comprising 18 Boeing 737 aircraft. They recently launched a project to equip this fleet with CMC's CMA-5024 for standalone LPV approach capability and ADS-B Out compliance with funding from the European GNSS Agency's (GSA) EGNOS Adoption for Aviation grant. By employing this LPV solution, ASL Airlines France will continue to strengthen and maintain its high quality of service to its customers.

Intuitive Cockpit

One of the greatest benefits of CMC's solution is the intuitive cockpit design that drastically reduces the cost of airline training. This is achieved by the reuse of the existing Gables NAV control panel, which comes factory fit from Boeing, for LPV approach selection. As this panel is already in use for ILS approaches, the design ensures all approach selection is centralized in the same cockpit location. The single difference from line fit is an annunciator indicating when an LPV approach is actively being flown.

Additionally, CMC's ADS-B Out integration is designed to be indistinguishable from that of Boeing, in terms of cockpit and flight crew perspective. The overall result is a simpler, more effective mental model for flight crews to absorb. In the words of one of the first pilots to fly an LPV on a B737: "From the pilot's perspective, CMC's LPV system provides a clean, straightforward interface which behaves exactly like an ILS, but with the exceptional (SBAS) performance and availability".

Airline Benefits
The use of the CMA-5024, is a cost effective alternative to replacing the current B737NG multi-mode receiver (MMR). When paired with any DO-260B compliant transponder, it allows operators to meet worldwide ADS-B Out requirements, including EASAs. It also allows airlines to take advantage of the EGNOS capabilities, specifically the increasing number of LPV approaches being developed all across Europe. These high precision GPS instrument approaches are equivalent to CAT I ILS approaches and do not require specialist crew training. Their aim is to reduce costs associated with flight delays and cancellations and provides airlines with a safe



Credits: CMC Electronics

approach to airports where ILS is unavailable. As indicated by one of the first B737 LPV customers: "The addition of LPV capability to our aircraft permits us to provide significantly improved schedule reliability for our scheduled and charter clients, given the absence of traditional ground-based approach aids at many of the remote destinations we serve".

Lastly, this solution future-proofs airlines, by offering a simple upgrade path for their B737NGs to benefit from advanced GNSS functions such as GBAS GLS by upgrading to CMC's new CMA-6024 GPS/GBAS/GBAS receiver system.

Given the enhanced performance provided by EGNOS along with the undeniable safety, reliability and cost-saving benefits of LPV approaches, the need to increase the number of EGNOS and LPV-compatible aircraft should be a top priority for regulators, airlines and manufacturers alike. The approval of an STC that allows one of the world's most popular aircraft models ever sold, the B737NG, to successfully fly an LPV approach is truly exciting news.

This well-developed solution stands out on many levels. It is cost effective, allows airlines to meet current mandates, provides a future path to LPV approaches and overall SBAS compatibility and provides flight crews with an intuitive interface. The hope is that this will encourage more airlines to operators than ever before to upgrade their fleets to EGNOS compatible.

“ Given the enhanced performance provided by EGNOS along with the undeniable safety, reliability and cost-saving benefits of LPV approaches, the need to increase the number of EGNOS and LPV-compatible aircraft should be a top priority ”

Source: EGNOS User Support / ESSP website

SAAB 2000

Örebro, Sweden: On Friday, August 10th, TAM's new, easy-to-install, LPV-solution for the Saab 2000 was fully certified by EASA (LPV – *localizer performance with vertical guidance*). Following the EASA certification, a corresponding FAA validation is in progress.

The smart and easy-to-install LPV-modification kit for the Saab 2000, developed in-house in collaboration with Canadian CMC Electronics, is tailor-made for the Saab 2000 and allows the cockpit layout to be virtually unaltered, utilizing current screens. When installed, modified aircraft will be able to make high-precision approaches to any airport, where older ILS-systems have been replaced with a GPS-based LPV solution due to cost. The LPV or RNP Approach equipped aircraft will be mandatory in Europe in early 2024.



- *“This exciting LPV-modification package, now on offer to Saab 2000 operators, actually began as a customer request”* says Pär Gulle, TAM Managing Director.
- *“As a major Saab 2000 operator realized last year that part of their traffic program would be affected by some airports retiring their ILS-systems, our engineering department was tasked to find a solution that would be as easy to install as to use. Now, the system is airborne and certified, thanks to our engineers’ deep knowledge of the Saab 2000, combined with a creative ability to ‘think outside the box’,”* Pär Gulle states.
- *“Finally, I also wish to thank EASA for a positive and highly supportive approach to this, meeting us with a professional attitude which was essential to the successful outcome,”* Pär Gulle says.

CMC's EGNOS-Enabled LPV Solution

- **Efficient, cost effective and low risk LPV retrofit solution**
 - Industry unique: only **standalone** (“bolt on”) solution
 - No FMS, autopilot, display updates required
 - **Certified** and flying in scheduled revenue service on B737, ATR42/72, SAAB2000, Airbus Helicopters and many other platforms

- **High reliability, MTBF and quality**
 - Avoids down-time – actual fixed-wing MTBF in service is > 550,000 hours
 - Only receivers to have no reported in-service issues or ADs

- **Easy and versatile installation**

- **Future ready:** Upgrade path to DFMC: Galileo and EGNOS v3

Conclusion

- **EGNOS v3 is on the forefront of the next generation of GNSS technology**
- **EGNOS v3 DFMC, coupled with Galileo GNSS constellation, will be a game changer in the Civil Aviation Community – next paradigm for CNS/ATM and PBN**
- **CMC is a long-term trusted partner and remains fully committed to the EGNOS community**

Thank you!

**On The
Button
Every time**

Advanced GNSS solutions
for Every Aviation Need

