CMC - Localizer performance with vertical guidance (LPV) Solution

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An ILS Approach or an ILS ‘Look-Alike’ Approach
Problem

- Schedule reliability for charter or scheduled flights due to absence of traditional ground-based approach aids on remote destinations.
  - Issues: Runways without ILS, severe weather, and night landing
- Reduce airport maintenance with planned removal of ILS facilities
- Cost of new infrastructure
  - ILS is costly to install compared to publishing an LPV approach
  - Maintenance: periodic LPV re-survey versus ILS antenna re-cal
- NPA are designed with step-down level-off segments: fuel burn
- ILS Weaknesses
  - Clear surrounding area (multipath issues)
  - Must be “on the runway”
  - ILS ground support equipment failures
  - Occasional glide-slope “glitches” causing go-arounds
- FAA current plan is to no longer establish new Category- I ILS
  - Ref.: CNS Task Force meeting August 17, 2011
Self-Contained LPV is the Solution

- Localizer performance with vertical guidance - LPV
- CMC has the complete solution…
Prepare for the future ... GBAS

LPV

Infrastructure GPS/SBAS (Air Ground)

Operation

STC

CMA-5024

CMA-5025

FAS

LPV
GPS/SBAS Infrastructure

- SBAS stands for Space Based Augmentation System.
- SBAS is the ICAO name for each state’s version of WAAS, EGNOS, MSAS, GAGAN, SDCM, SNAS
- SBAS systems around the world are compatible!
GPS/SBAS Infrastructure (Cont.)

- WAAS, provided by the FAA, is the SBAS system covering USA, Canada and Mexico
GPS/SBAS Infrastructure (Cont.)

EGNOS is the SBAS system covering Europe
GPS/SBAS Infrastructure (Cont.)

- GAGAN is the SBAS system covering India
GPS/SBAS Infrastructure (Cont.)

- MSAS is the SBAS system covering Japan

MSAS Configuration
GPS/SBAS Infrastructure (Cont.)

- SBAS systems in development: Russia (SDCM) and China (SNAS)
Infrastructure – WAAS Published approaches

• US : Currently 2785 LPV approaches published (5 April 2012)
• Canada: 128 LPV approaches published (April 2011)
Infrastructure – EGNOS Published approaches

- 92 LPV/APV Baro published in Europe (March 2012)
- Many more are planned
  - France, Germany, Spain, Italy, Poland, Belgium, Netherlands, UK, Czech Republic, Slovakia, Austria, Finland, Northway, Portugal
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CMA-5024 GLSSU Landing Solution

- CMA-5024 GLSSU Characteristics:
  - Certified to:
    - TSO-C145c BETA-3 (navigation sensor)
    - RNP Navigation & SA-Aware
    - TSO-C146c DELTA-4 (ILS replacement)
    - SBAS Approach
    - Integrated ILS-GLS High Integrity Switch
    - Software upgradeable to GBAS/LAAS

- Very successful FAA flight tests at FAA Tech Center (September 2007)

- Full ADS-B compliance
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CMA-5025
CMA-5025 GLSSU Control Panel

- With CMA-5024, it provides a fully functional, stand-alone LPV system. It is used to select/enable LPV approach.
- Meets all RTCA/DO-229D LPV approach requirements without waiver or exception.
- FMS not required to enable LPV
  - A fully independent stand-alone LPV capability, “bolts-on” to existing aircraft
  - Integrated OEM FMS solutions possible
- GBAS capable, RTCA/DO-253B GLS approach ready
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FAS
Final Approach Segment (FAS)

- FAS is a specific segment of the LPV Database.
- FAS contains all the path construction information.
- FAS is used to define the final approach path (from the FAF to the published DH)

‘A FAS is the approach path which is defined laterally by the Flight Path Alignment Point (FPAP) and Landing Threshold Point/Fictitious Threshold Point (LTP/FTP) and defined vertically by the Threshold Crossing Height (TCH) and Glide Path Angle (GPA)’

Details in RTCA/DO-229D
Final Approach Segment (FAS) Data Block (cont.)

- CMA-5024 hosts 2 complete cycles (previous and current) of the entire world-wide SBAS approach database (FAS)
- FAS database is loaded via a data-loader interface
- Updated every 28 Days (same as the FMS NavDB)
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Infrastructure GPS/SBAS (Air Ground)

LPV

Operation

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FAS
LPV STC

- Canadian STC for B737-300/400/500
- FAA and EASA STC on-going on B737
- Working on the same approach for B-757, B767, B777, A300 and other A/C types
- CMC’s CMA-5024 GLSSSU and CMA-5025 Control Panel provide a Stand-Alone LPV system designed for retrofit. It is an ILS Look-Alike system.
- Proven solution, proven STCs. CMC LPV solution can be STC’d in any environment.
Canadian North STC on B737-300

• Successful certification
  – Canadian North
    • Operational Support
  – CMC
    • CMA-5024 GLSSUs
    • CMA-5025 Control Panels
    • Antennae
  – LogicAir
    • Development,
    • System Installation,
    • Engineering & STC
TRANSAERO B737-300/400/500

- Program On-Going
- Currently updating 23 aircraft
- TCCA STC obtained
- FAA/EASA STC submitted
- LogicAir
  - Development,
  - System Installation,
  - Engineering & STC
B737 Top Level Block Diagram – After Install
Boeing 737 Installation Pictures - GLSSU

- GLSSUs are installed in the ceiling of the B737 500 Area
- Use the Boeing provisioned supports when available
Boeing 737 Installation Pictures – D/A

- ILS and DME Interface
- Analog to Digital Converter
Boeing 737 Installation Pictures – Control Panel & Annunciators

- CMA-5025 installed on the Pedestal
- Annunciators installed in Pilot Primary Field of View

Current B737 certification also allows use of other pedestal locations
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GBPAS

LPV

Infrastructure GPS/SBAS (Air Ground)

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FAS

STC

Operation
Operation

According to Chris Drossos, 737-300 project pilot for Canadian North

"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 Canadian destinations we serve. From the pilot's perspective, CMC's LPV system provides a clean, straightforward interface which behaves exactly like an ILS, but with the exceptional WAAS performance and availability."
Operation

• LPV approaches/vertical guidance derived *exclusively* from SBAS and are not affected by temperature.
• Design criteria is very much like an ILS and can be as low as 200 with a half mile visibility.
• AC 90-107 provides guidance for operational approval

![Advisory Circular]

- OpSpec/MSpec/LOA paragraph C052 and C053 provide guidance on training requirements
Operation - Plates

1. LPV is a RNAV (GNSS) procedure
2. 5 digit WAAS
   Channel Number
   WAAS Ch 80090
3. WAAS Approach ID:
   W=WAAS, Runway 13,
   A= 1st approach on that Runway
4. LPV DA (H)

By definition, channel number will always be 5-digits:
WAAS channel numbers from 40000 to 99999
LAAS channel numbers from 20000 to 39999
Operation - Plates

1 LPV Minima
Operation - Example

• Flight Crew Actions
  – Select a RNAV Approach plate for Runway (example RNAV 13R) for the LPV approach
  – **New Action:** Enter the 5 digit number into the Control Panel, the 5 digit number is obtained from the approach plate’s WAAS Channel Number, eg 80090.
  – **New Action:** Select LPV approach using source select switch on forward instrument panel.
  – Maintain map mode on ND during approach
  – Select LAND/ILS mode on autopilot
  – Autopilot transitions to ILS/LPV as per normal
  – FMS indicates normal precision approach
  – Pilot flies LPV like a standard Cat I ILS approach procedure
    • Missed approach as per ILS
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Infrastructure GPS/SBAS (Air Ground)

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FAS

STC

OPERATION

LPV
Localizer performance with vertical guidance (LPV)

- Operational Benefits
  - LPV is ILS Look-Alike
  - LPV plates are RNAV procedures
  - LPV is here and is expanding globally.
  - Implementation brings immediate savings
  - Installation in all aircraft is a reasonable and achievable bolt-on task
  - The CMA-5024 is certified, airline proven-in-service, with LPV
  - Reduced dependence on terrestrial navaids
    - Improved dispatch reliability SIDS (use SBAS as navigation source)
    - Improved STARS (use SBAS as navigation source & LPV)
    - Can continue LPV operations when ILS is out-of-service to all runways
  - Enhanced operational safety due to the vertical guidance provided
  - No operational limitation due to cold weather
  - Integrated solution exists with CMA-9000 FMS
Localizer performance with vertical guidance (LPV) (Cont.)

• Infrastructure benefit
  – Terrain variation does not impact publication of a LPV approach
  – No maintenance (contrast this to ILS continual flight inspection)
  – All SBAS services are interoperable (WAAS, EGNOS etc.) so only one type of SBAS receiver is required

• FAA – LPV published advantages: (source: Federal Aviation Administration Implementation of WAAS LPV Procedures) – published in 2004
  – Procedure Integrity
  – Lower Minimums
  – Significantly increases the number of available instrument approaches
Prepare for the future ... GBAS

Infrastructure
GPS/SBAS
(Air Ground)

CMA-5024

CMA-5025

FAS

LPV

Operation

STC
Prepared for the Future… GBAS

- GBAS/GLS is very similar to SBAS/LPV operationally, both deliver CAT-I performance.
- GBAS is expected to deliver CAT-I to CAT-III operations; however, certification to CAT-II/III does not exist at this time, and GBAS CAT-I not deployed yet.
- Differences between the systems
  - LPV receives error corrections from SBAS geostationary satellites, GLS receives error corrections via uplink from GBAS ground station.
  - LPV Final Approach Segment (FAS) is hosted in the avionics database, GLS FAS uplinked via VHF Data Link from the GBAS ground station.
  - Concepts between GBAS/GLS and SBAS/LPV are highly similar except GBAS GLS requires ground stations to work, SBAS LPV is self-contained
- CMA-5025 will provide GBAS capability when infrastructure will be available
SBAS Performance: RNP0.1 Meets/Exceeds ADS-B requirements
Bolt-On LPV/Growth to GLS
ILS ‘Look-Alike’ Approach System
Certified GPS/SBAS LRUs
Proven STC solutions

Infrastructure

GPS/SBAS (Air/Ground)

CMS-5024

CMS-5025

FAS

STC

Operation

LPV

CMA-5024 is prepared for the future
END