GBAS CAT III- Optimized low visibility operations

Validation of the use of GBAS precision approaches for improved runway throughput in poor weather conditions

Renée Pelchen-Medwed, Lendina Smaja, Anna Wennerberg
Eurocontrol
June 23rd 2015
OUTLINE

1. Problem statement – Todays operation
2. Solution – Operational concept
3. Validation – Objectives
4. Validation – Approach and Method
5. Validation – Results & Conclusions
CAT II / III

A category II approach is a precision instrument approach and landing with decision height lower than 60m (200ft) but not less than 30m (100ft), and a runway visual range not less than 350m (1200ft) (ICAO)

A category III approach is a precision instrument approach and landing with no decision height or a decision height lower than 30m (100ft) and a runway visual range not less than 200m (700ft). (ICAO/FAA)
Drawbacks of Instrument Landing System (ILS) in CAT III

- Restrictions on building development and aircraft movements
- ILS is installed in the runway area (multi path effect)
- Large ILS protection areas in CAT III
- CAT III holding points
- Longer Runway Occupancy Time

Reduced Capacity
Reduced capacity because the controller shall:

- Use CAT II/III holding points
- Protect the ILS sensitive area
- Increase separation between landing and departing traffic
- No longer give conditional clearances
- Give taxi clearances with precaution and monitor his ground radar
Concept developed within the Framework of SESAR (GBAS operational implementation)

- One GBAS station for all runway ends
- Less prone to interference than ILS as station is located outside aircraft movement area
- No false capture
- GBAS HMI on board is ILS look alike
- Reduced flight inspection costs
GBAS in CAT III to improve runway throughput

- Landing clearance line (closer than CAT III holding points)
- Later landing clearance (1NM)
- Reduce final approach spacing
Validate the increased runway capacity in poor weather conditions brought about by the use of GBAS CAT II/III for precision approaches.

- To assess the increase of runway throughput in LVP
- To evaluate the suitability of runway safety nets and assess the safety of optimised LVP operations based on GBAS
- To evaluate the ATC workload and the new ATC procedures for final approach spacing
- To validate that provision of late landing clearance by ATC does not impair the pilot capability to prepare the landing
Main Key Performance /Transversal Areas

- **Capacity**
  - Runway throughput

- **Safety**
  - Separation infringements
  - Runway incursions
  - Go-arounds etc.

- **Human Performance**
  - Workload
  - Situational Awareness
  - HMI usability
  - Acceptability of Procedures
4 Validation–Approach and Method 1/9

- Stakeholder workshop
- Safety & Human Performance Assessment
- Real-Time Simulation

*E-OCVM
Stakeholder workshop

- Pilots
- Air traffic controllers
- Concept developers
- Engineers
- Human Performance & Safety experts

Decision on procedures for RTS

- Landing clearance line
- Landing clearance
Safety (Safety Reference Material)

- Success & failure approach
- Concept can perform safely under normal, abnormal & degraded modes
- Safety requirements are realistic and achievable

Level of safety are at least as good if not better than in current CATII/III operations
Human Performance Assessment (HP Reference Material)

- Proposed human roles are consistent with human capabilities
- Contribution of the human supports expected system performance and behaviour

Informs concept design & development
Real-time simulation

- EUROCONTROL eDEP/ITWP - Early Demonstration and Evaluation Platform / Integrated Tower working position

- EUROCONTROL ESCAPE – A real-time air traffic control simulator for en-route, TMA and approach

- EUROCONTROL MCS - Multi Cockpit simulator
Real-time simulation – simulated environment

- The simulated Airport was Paris CDG
- Only one runway to the north RWY 27L
- RWY 27L was used for arrivals only and in mixed mode arrivals/departures
Real-time simulation

- Simulation set up
  - 3 days of training
  - 12 runs (1 hour) in one week of simulation
  - 3 runs with safety scripts

- Participants
  - Three ATCO from ENAV licensed in Approach and Tower
  - Three pilots from Airspace User community

- Positions
  - Final approach position
  - Tower runway position
  - Pilot Cockpit
  - Pseudo pilots
Safety scenarios- Pseudo Pilots were instructed

- Wrong read back (ILS instead of GBAS/GLS)
- On ground equipment failure
- On-board equipment failure (Failure within 10nm & outside 10nm)
Real-time simulation – simulated scenarios

- ILS arrivals only (reference scenario)
- ILS arrival/departures (reference scenario)
- GBAS arrivals only
- GBAS arrival/departures
- GBAS/ILS arrival only (60% GBAS)
- GBAS/ILS arrivals/departures (60% GBAS)
Capacity

**Expectation:** More or the same number of landings take place in the solution scenarios compared to the reference scenarios.

The expected benefit was observed in the segregated runway scenario where more landings took place in the GBAS scenario.
Safety

**Expectation:** No increase in separation minima infringements for non-wake aircraft pairs and for wake aircraft pairs in the solution scenarios compared to the reference scenarios.

Segregated runway: more separation infringements with ILS than with GBAS.

[Graphs showing loss of separation for non-wake and wake pairs with ILS and GBAS for different arrival mixes (APP and TWR).]
Safety

**Go-arounds – Expectation:** The number of go-arounds is not greater in the solution scenario than in the reference scenario

- Segregated runway: no go-arounds were recorded in GBAS scenarios (1 in ILS scenarios)
- Mixed mode runway: no go-arounds in 60% GBAS, two go-arounds in GBAS 100% and two go-arounds in ILS 100%

**Runway incursion – Expectation:** Number of runway incursions shall not be greater in the solution scenarios compared to the reference scenarios

- Only one runway incursion recorded (GBAS 100%) ➔ No conclusion
Safety Scenarios

- Wrong read-back not always picked up (for both GLS & GBAS)
- Procedures for ATCOs acceptable
- Pilots did not agree with the criteria for go-around (10nm)
Human Performance

Workload – Expectation: Workload will be not “significantly” higher in the solution scenario than in the reference scenario/ the level of workload is within acceptable limits.

Mixed mode runway: Highest workload in ILS 100%
Segregated runway: workload satisfactory. No high workload recorded
Human Performance

Situational Awareness–Expectation: Situational awareness will not be lower in the solution scenario than in the reference scenario / SA is within acceptable limits

Higher or the same level of situational awareness was recorded in the solution scenarios compared to the reference scenarios. The lowest situational awareness was recorded in the ILS 100% mix.
Human Performance

**HMI usability - Expectation:** The controllers score the ATC HMI as being usable/acceptable

**Questionnaire:**
- Label (G/I) and interaction
- Landing clearance limit
- GBAS landing clearance line

The HMI was very well received and accepted
Human Performance

Acceptability of procedures - Expectation: The controllers score the procedures being usable/acceptable

Questionnaire:
- Late landing clearance
- When to “frame” a G/I
- Phraseology

Segregated runway: The procedures were acceptable (pilots & controllers)
Mixed mode runway: The late landing clearance & reduced spacing raised concerns.
Phraseology: the proposed “GLS” was not unanimously accepted
Capacity
No negative impact on capacity

Increased throughput can be reached
Safety
Segregated runway environment
The final approach spacing for arrival only runway configuration was considered appropriate

Level of Safety can be maintained

Mixed mode runway
The final approach spacing for mixed mode runway need to be fine tuned according to airport local constraints

Level of Safety was decreased
Human Performance

- Workload and Situational awareness acceptable
- Positive feedback on HMI elements
- Positive feedback on procedures
The GBAS in LVP operations for segregated runways can bring the expected runway throughput benefits without negatively impacting safety and human performance.

The mixed mode runway environment needs further assessment taking into account local airport characteristics.
THANK YOU!

renee.pelchen-medwed@eurocontrol.int
lendina.smaja@eurocontrol.int
anna.wennerberg@eurocontrol.int