Update of the ITU-R M.1466 recommendation for EFVS applications

FSMP WG/3
6 to 14 September 2016

HIGHER TOGETHER™

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Rev.	A
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DASSAULT AVIATION

Enhanced Flight Vision System

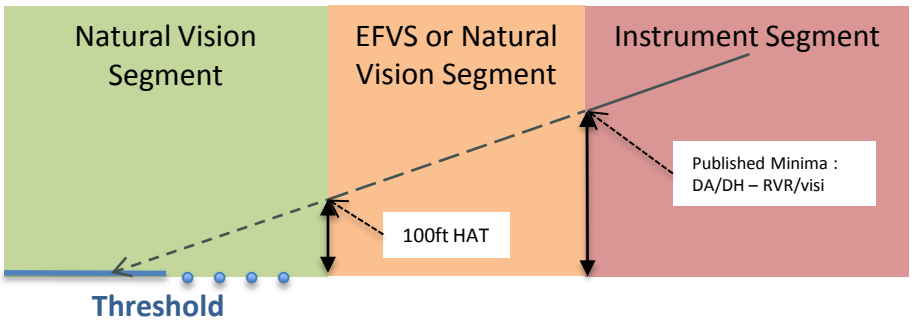
- EFVS is a system composed of a head-up display (HUD) and an imaging sensor
- The image from the sensor is displayed to the pilot with superposed navigation and guidance information

*« An EFVS uses a head-up display (HUD) to provide flight information, navigation guidance, and a **real-time image of the external scene** to the pilot on one display. The real-time image of the outside scene is produced by **imaging sensors**, which may be based on **forward looking infrared**, millimeter wave radiometry, **millimeter wave radar**, low level light intensification, or other imaging technologies »*

Extract from US regulation (NPRM)

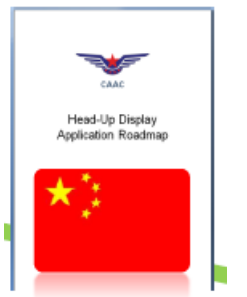
EFVS…

- enables lower decision heights and reduced runway visual range
- and thus provides increased accessibility to the airport in low visibility conditions



EFVS benefits

- EFVS provides the opportunity to reduce the overload on big airports equipped with CATII/III ILS which, otherwise are the only ones to be approachable in low visibility conditions…
- …by giving access to small and mid-size airports unequipped with CATII/III ILS.
- EFVS is of particular relevance in air traffic high-growth areas which are not adequately equipped
  - China : CAAC HUD Roadmap
  - other areas in Asia…

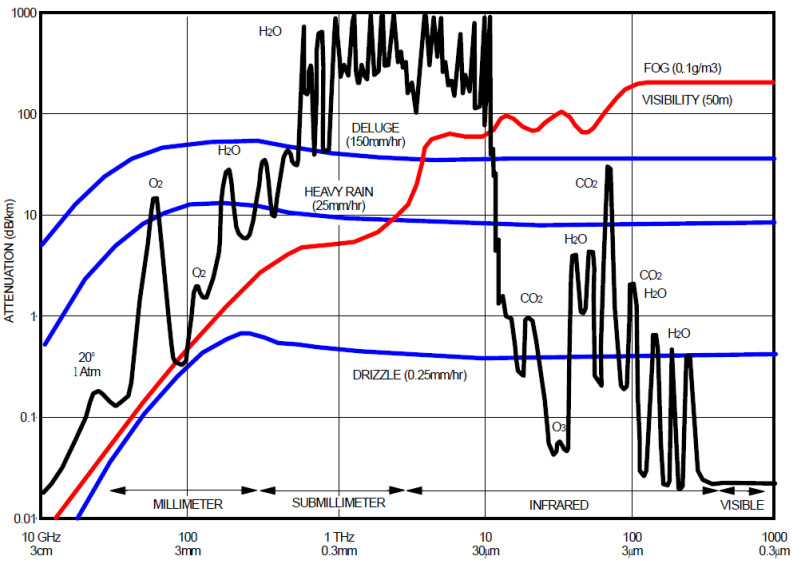


Current situation

- many EFVS systems based on IR technology are certified on business jets
- but the operational benefit is limited because of :
  - low clouds, heavy fog, rain…
  - the use of LED technology for runway lighting

MilliMeter Wave Radar for EFVS

- MMWR technology is the best candidate for future EFVS sensor



- Developments and experiments are currently under progress by some equipment suppliers in the world.

FAA's point of view about MMWR

«Current enhanced flight vision systems use infrared-based (IR-based) sensors. While IR-based sensors provide the required enhanced flight visibility in certain visibility-limiting conditions, they currently do not provide the enhanced flight visibility required by the operating rules for EFVS to support operations in lower visibility ranges. Industry is developing other sensor technologies, ***such as millimeter wave radar****, that are not limited in the same ways that IR-based sensors are limited. These efforts are still developmental, but show promise.»*

Extract from NPRM Federal Register / Vol. 78, No. 112 / Tuesday, June 11, 2013 / Proposed Rules, p34948

Band selection for MMWR EFVS

- Need for a high frequency to get a sufficient angular resolution in order to allow the pilot to discriminate characteristic features on the image.
- Atmospheric attenuation must be low

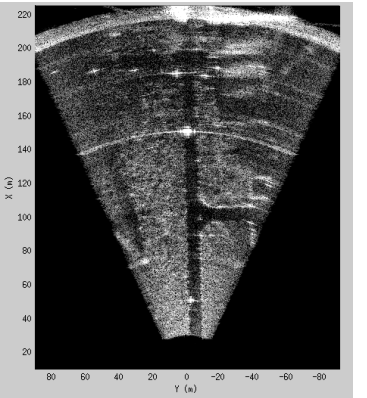
Ka and W are the only possible frequency bands for MMWR EFVS

Advantages of the Ka band

- it has a better penetration of the atmosphere
- it benefits from technologic and industrial developments in the field of telecommunications.

  → it allows the development of affordable antenna arrays with no mechanical gimbals, which make it easier to integrate on an aircraft.

Studies and developments carried out by Dassault Aviation and its partners



- Radar imagery in Ku band with a mockup
- Studies for the integration of a 1D linear array in Ka band
- Ground reflectivity measurements in Ka band at very low grazing angles in different weather conditions (dry and wet soil, …)
- Radar imagery in 31.8-33.4 GHz band with a mockup

Studies carried out in the frame of FENICS and IKKY projects supported by French government and aircraft national service provider DGAC.

ITU-R M.1466 recommendation

At the request of Dassault Aviation,

the ITU-R M.1466 recommendation has been updated to take into account the characteristics of the radar under study for EFVS application.

THANK YOU