AXIS ELECTRONICS

TECHNOLOGY AND SERVICE IN QUALITY MANUFACTURING

REDUCED RUNWAY OCCUPANCY TIMES.

INTRODUCTION.

1. Landed pilots, particularly in reduced visibility, have little in the way of cues to assist them in reaching Runway Exits at the optimum ground speed. As a consequence, aircraft are usually decelerated early in the landing to speeds much lower than those required to safely, and comfortably, arrive at the exit. The result of this natural desire to 'get the speed down' causes extended Runway Occupancy Times, the single most important factor in airport capacity.

2. Through an FAA Runway Incursion Prevention Programme it has been demonstrated that, through low powered transmitters and taxiway embedded antennas, aircraft Marker Receivers can provide 'clear voice' airfield positional information to taxiing pilots. The obvious benefit of the scheme, named Ground Marker, is that no changes are required to aircraft or equipment.

3. By using a variant of the Ground Marker system to advise landed pilots of their precise 'Distance to Go' to Runway Exits it has been shown that Runway Occupancy Times may be significantly reduced. This benefit is particularly important with single runway airports.

4. The rationale behind the scheme is that pilots, knowing they will receive accurate call-outs of 'Distance to Go', may safely allow aircraft ground speed to decay at a rate slower than otherwise with the last 1,000 feet to the exit being used for any final speed adjustments.

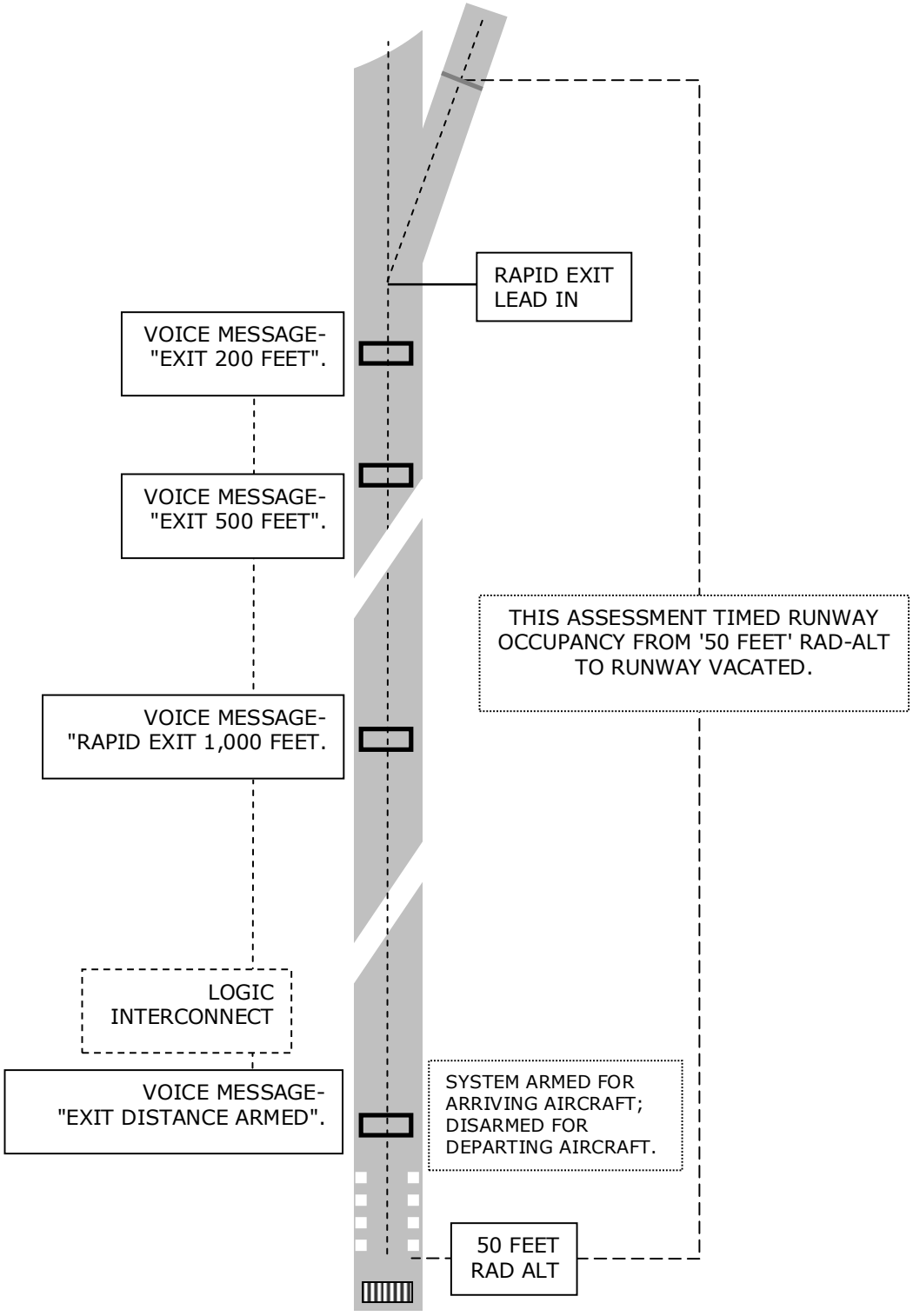
5. Implementing the scheme involves embedding antennas at selected points on the runway, installation of Inductive Loop aircraft detection devices and low powered 75MHz radio transmitters with the appropriate voice messages stored in digital form. Additionally, the system could allow ATC to select the exit from which they would *prefer* a landed aircraft to vacate the runway.

6. For an initial assessment trial were conducted using a 737-800 flight simulator operated by highly experienced Air Transport rated captains.

7. A simplified schematic of a practical runway installation is shown overleaf.

GROUND MARKER™ AND THE FUNCTIONS DESCRIBED HEREIN ARE THE SUBJECT OF INTERNATIONAL PATENTS.

PLAN VIEW, SIMPLIFIED RUNWAY INSTALLATION.



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DESCRIPTION OF TRIAL.

1. The trial used an advanced technology 737-800 simulator of Boeing/Flight Safety, UK. Two 747 rated captains operated the simulator; one flying and one working from the operator's console to provide voice call-outs of Distance to Go to the runway exit.

2. The operator's console provided a Visual Display Unit with an accurate plan view of aircraft position on the runway. This allowed the pilot not flying to precisely determine the Distance to Go to the Rapid Exit. To ensure accuracy of the display the system was initially 'calibrated' by taxiing the aircraft to the Rapid Exit and then applying Distance to Go markings to the VDU display. Markings were at 1,000, 500, and 200 feet from which the pilot not flying could produce distance call-outs on cue.

3. A series of Cat 3b approaches and landings (Runway Visual Range 300 Feet/100 Meters) were made into London, Gatwick. Four approaches, landings and unassisted runway vacation sequences were completed using standard Cat 3b procedures to produce an average time from the 50 Feet Rad Alt call-out to 'runway vacated'. The use of the 50 feet Rad Alt call-out, rather than touch-down, was to maintain a consistent start-point for timing.

4. The average Cat 3b Runway Occupancy Time of 70 seconds was accepted as reasonable by the pilots, Gatwick being their home base.

5. Following this, a further ten approaches, landings and runway vacation sequences were flown, under the same Cat 3b conditions but with Runway Distance to Go voice call-outs provided by the pilot at the console VDU.

6. The results are shown on the comparison table overleaf.

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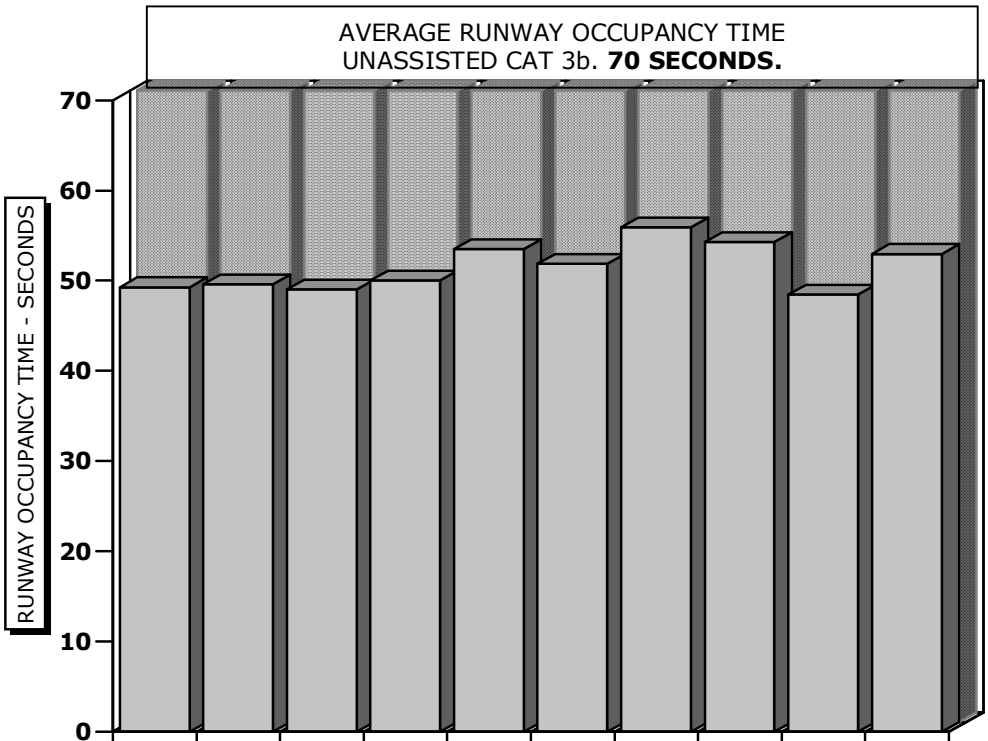
Saving 5 seconds per movement has the potential to increase capacity by 1 to 1.5 movements an hour.
(Source: UK National Air Traffic Svcs.)



	1	2	3	4	5	6	7	8	9	10
VOICE ADVISORY	49.3	49.6	49.0	50.0	53.5	51.9	55.9	54.3	48.5	53.0
NO VOICE ADVISORY	70	70	70	70	70	70	70	70	70	70

COMPARATIVE OCCUPANCY TIMES

OCCUPANCY TIME, FOR THIS TRIAL, WAS FROM 50 FEET RAD ALT TO RUNWAY VACATED.

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CONCLUSIONS.

1. The purpose of the trial was to determine whether landed pilots could, with the benefit of clear-voice Distance to Go to Runway Exits, vacate the runway in a shorter time than normal.

2. The trial's primary consideration was that the pilot flying should not feel that safety, or control of the landed aircraft, was in any way compromised or degraded.

    - The results were remarkable. Runway Occupancy Times in Cat 3b conditions matched those *normally expected in clear visibility landings*.

    - The pilot flying reported a sense of increased control through improved situational awareness. He further commented that he can think of no set of circumstances where the scheme could create a decrease in safety.

3. From the results, although the trial was necessarily brief, Reduced Runway Occupancy times of major significance are easily attainable.

4. As mentioned, the system involves no change to aircraft, only the relatively simple installation of runway equipment. From this, an airport could benefit from substantial decreases in Runway Occupancy Times *by all user airlines* from the time of system commissioning.

5. In addition to the benefits of Reduced Runway Occupancy the scheme offers gains in other areas. For example, it was found that Auto Brake settings could be reduced from 3 (normal Cat 3b) to 1 (737-800) with attendant savings in brake wear, and increased passenger comfort.

6. Once pilots adapt to the procedure the decreased use of thrust reversers would undoubtedly be a further gain, with attendant benefits in noise, emissions, and other environmental issues.

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George Newby. george.newby@fly.virgin.com
John Watkins. john.watkins@fly.virgin.com

Author. Nigel Corrigan. groundmarker@axis-electronics.com Rev. June 2005.

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