Randy Sleight
JHU/APL

October 10, 2006

Determination of Minimum Tracking Capacity Requirements for ASA Applications

Introduction

The ASSAP SG is investigating requirements to be included in the ASA MOPS for the minimum track processing capacity of the ASSAP function. The track processing capacity requirements depend on the coverage volume requirements in the ASA MASPS and the number of targets expected to lie within the coverage volume. For the purposes of this analysis, we examined the LA2020 traffic scenario. It is assumed that the ASSAP function must have the processing capacity to handle the traffic densities associated with this scenario. Thus, to determine the minimum tracking capacity, the LA2020 traffic densities are applied to the coverage volumes specified in the ASA MASPS to arrive at a total number of targets in each coverage volume.

Methodology

The ASA MASPS specify minimum service volumes for the 5 ASA applications. These are derived from application specific criteria, such as time to alarm and minimum separation distances. The coverage volume requirements from the ASA MASPS (R3.160) Table 2-3 are:

- EVAcq and EVApproach: 10 NM @ +/-3,500 ft
- Conflict Detection (CD): 45NM @ +/-20,600 ft[1]
  (Table D-28 lists the following for CD: 45 NM @ +/- 20,600 ft for the High Altitude En route domain, 18 NM @ +/- 15,500 ft for the Terminal domain, and 2.62 NM @ +/- 2,700 ft for the GA Traffic domain.)
- ASSA and FAROA: Airport maneuvering area, and within 3 NM runway threshold and < 1,000 ft AGL.

Since the CD application necessitates the most demanding requirements, the CD coverage volume requirements are the design goal. The CD coverage volume requirements are based on the Conflict Detection Zone (CDZ) alert times, as specified in Table D-28. These are the times the crew must be alerted before penetration of the CDZ, which envelopes the aircraft horizontally 5NM (En Route) and vertically +/- 600 ft. Note 17 of Table 2-3 states that coverage volumes may decrease for limited performance aircraft, as maximum horizontal and vertical closing speeds may be reduced. GA aircraft may take advantage of this statement because the CD coverage volume is derived from the high altitude en route domain parameters in Table D-28, which specifies a closing speed of 1,200 knots (600 per aircraft). If a GA aircraft is not expected to exceed 200 knots, this closing speed can be reduced to 800 knots. The appropriate coverage volume would then be the distance traveled given the new closure rate and CDZ alerting time, resulting in 27 NM (120 sec * 800 NM/hr * .00027 hr/sec).

The processing capacities are calculated by applying the LA2020 traffic density, as defined in Section 3.2.2.2.2. Basically, this scenario prescribes 5.25 aircraft to each 1 NM ring reaching from the center of the scenario, LAX, where there lie an additional 100 ground vehicles and 75 aircraft on the ground. The aircraft are distributed exponentially in altitude with a 5,500 ft mean. The center is the densest position in the scenario, and accordingly is the focus of our traffic

[1] Table D-28 reports this value to be 15,600 ft. However, this appears to be an error. The true value, given an assumption of 10,000 fpm vertical rates, 120 sec alarm time, and 600 feet CDZ, is 10,000(ft) * 2(min) + 600 = 20,600 ft.

capacity calculations. The scenario has been implemented in a tool called TrafGen. This tool is non-deterministic, requiring statistical results to be reported.

Processing Capacities

The following table presents the resulting average traffic count for the various coverage volumes described above.

LA2020 Target Counts for Various Coverage Volumes									
Range (NM)	Altitude (+/-ft)	Own Altitude (ft)	Equipage Category					Ground A/C	Airborne A/C
			A0	A1L	A1H	A2	A3		
45	20,600	20,600	72	113	33	40	117	141	234
45	15,600	15,600	72	113	32	40	117	141	234
45	15,600	20,000	24	38	12	14	38	0	125
45/18[2]	15,600	15,600	37	55	18	21	59	75	114
18	15,500	15,500	35	50	14	19	51	75	93
10	3,500	3,500	23	37	8	12	33	75	37

The first two rows indicate the required processing capacity is around 230 targets (only airborne aircraft are of concern in CD), regardless of the altitude limits. Row 3 indicates that the processing capacity reduces to 125 targets for an aircraft at 20,000 ft. It can be argued that the en route coverage volume should not be applied below en route altitudes. Row 4 indicates that the en route requirements reduce to 114 targets when the terminal coverage volumes are applied below 10,000 ft. Row 5 indicates the terminal domain requires a processing capacity of 93 airborne targets. In the case that both FAROA and CD applications are in use, 30 ground targets are added to the airborne targets, increasing the terminal processing capacity to around 120 targets.

[2] Corresponding with the terminal domain, an 18 NM coverage volume range is applied below 10,000 ft.