



REMOTE UNIT (RU) INTERROGATION SETUP

NUAIR WAM System – FAA UAS Test Site
Griffiss International Airport, Rome, NY

July 5, 2016
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REMOTE UNIT LOCATIONS

a) The number and location of the transmitter/receiver stations and receive only stations

ols	Coordinate					
RU Location	Lat	Lon	RU Type	Antenna Type	Antenna Model	Peak Output Power
RU01 - KRME ATCT	43.226759°	-75.406044°	RT	Omni	DME-5100a	50 dBm
RU02 - JPJ	43.342413°	-75.421148°	RT	Omni	DME-5100a	50 dBm
RU03 - Steuben	43.370365°	-75.284011°	RT	Omni	DME-5100a	50 dBm
RU04 - 911 Call Center	43.155020°	-75.376682°	RT	Omni	DME-5100a	50 dBm
RU05 - Kirkland	43.037222°	-75.446667°	RT	Omni	DME-5100a	50 dBm
RU06 - Florence	43.413028°	-75.680028°	RT	Omni	DME-5100a	50 dBm



REMOTE UNIT INTERROGATIONS

- Maintainability
 - The interrogations used for ATCRBS equipped aircraft and UAS use a technique called "*whisper shout*" that has been utilized using the same remote unit equipment and technology used in the FAA's ASDE-X and ASSC programs.
 - This equipment has previously obtained NTIA SPS Certification under Control Number SPS-17234/2, ERP-1129, dated November 30, 2012.

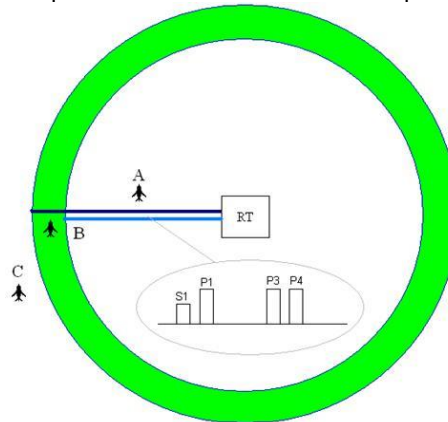
REMOTE UNIT INTERROGATIONS

The Whisper / Shout configuration only applies to adapted RTs. Whisper / Shout refers to an interrogation technique that was initially designed for use with the Traffic Collision Avoidance System (TCAS) that is now required on all commercial aircraft. The MLAT system uses the Whisper / Shout technique to interrogate ATCRBS targets. Since ROs do not transmit interrogations, this configuration does not apply to ROs. The Whisper / Shout technique is used to limit the number of targets that respond to each transmitted ATCRBS interrogation. Each Whisper / Shout step is an ATCRBS interrogation.

The Whisper / Shout parameters consists of three things: the number of interrogation steps, the power level of the interrogation pulses (P1, P3, and P4), and the power of the suppression pulse (S1). Each step can use its own interrogation and suppression pulse power level. The complete set of steps is executed each time the RT in question is commanded to perform an ATCRBS (or W/S) interrogation.

ATCRBS interrogations use a simple encoding technique based on the amount of elapsed time between the first and second pulses detected by the target. Normally the P1 and P3 pulses are separated by 8 or 21 microseconds (to elicit Mode A and Mode C responses respectively). If a second pulse is detected with 2 microseconds of the first pulse, the target's transponder does not respond at all. This is called being "suppressed". The MLAT system, by transmitting a suppression pulse (S1) at a lower power level 2 microseconds before the first interrogation pulse (P1), can effectively limit the number of targets that respond to individual interrogations. In the figure below, a single Whisper / Shout step is depicted. In this case, the interrogation pulses (P1, P3, and P4) are strong enough to reach the outer edge of the green ring (shown by the dark blue line). The suppression pulse (S1), which uses slightly less power, is only detected as far away as the inside of the green ring (shown by the light blue line). This step results in only those targets inside the green ring responding. Target A detects the interrogation pulse, but also detects the suppression pulse. Target C is too far away, and does not detect either pulse. Only Target B detects the interrogation pulses and does not detect the suppression pulse. Only Target B responds to this interrogation step. Note the P4 pulse is only used to suppress Mode S transponders from responding to W/S interrogations. ATCRBS transponders do not process the P4 pulse.

The goal of a Whisper / Shout configuration is to shift the power levels so that sufficient responses are elicited from all of the targets of interest.



Whisper Shout Interrogation & Suppression Power Levels

INTERROGATION POWER LEVELS

b) The interrogation power level(s) employed by each transmitter/receiver and maximum/minimum interrogation ring.

System				
Xmit Power	TPwr	50		
Steps	stp	10		
Int Step	IStp	3		
Supp Step	SStp	4		
AC Type	AC	IFR		
Step	Int dBm	Sup dBm	Int Rings	
			Max	Min
1	50	46	39.12	24.68
2	47	43	27.69	17.47
3	44	40	19.60	12.37
4	41	37	13.88	8.76
5	38	34	9.83	6.20
6	35	31	6.96	4.39
7	32	28	4.92	3.11
8	29	25	3.49	2.20
9	26	22	2.47	1.56
10	23	0	1.75	0.12

System				
Xmit Power	TPwr	50		
Steps	stp	10		
Int Step	IStp	3		
Supp Step	SStp	4		
AC Type	AC	VFR		
Step	Int dBm	Sup dBm	Int Rings	
			Max	Min
1	50	46	22.00	13.88
2	47	43	15.57	9.83
3	44	40	11.02	6.96
4	41	37	7.80	4.92
5	38	34	5.53	3.49
6	35	31	3.91	2.47
7	32	28	2.77	1.75
8	29	25	1.96	1.24
9	26	22	1.39	0.88
10	23	0	0.98	0.07

INTERROGATION SCHEDULING

b) The interrogation rate and power level(s) employed by each transmitter/receiver location

- Interrogation Scheduling
 - The interrogation schedule is based on three one second time periods. Listed below are the three one second interrogation schedules adapted for the NUAIR WAM system.

RU	ru1	ru2	ru3	ru4
Offset (60ms)	0	250	500	750
Type	A	AC 175	A	AC 185

Whisper Shout Interrogation Schedule 1

Schedule 1, consists of RU1 with a Mode-A singlet, RU2 with a 250 ms offset and Mode-AC doublet, RU3 with a 500 ms offset and Mode-A singlet, and RU4 with a 750 ms offset with a Mode-AC doublet.

INTERROGATION SCHEDULING

b) The interrogation rate and power level(s) employed by each transmitter/receiver location

- Interrogation Scheduling

RU	ru5	ru6	ru1	ru2
Offset (60ns)	0	250	500	750
Type	AC 175	A	AC 185	A

Whisper Shout Interrogation Schedule 2

Schedule 2, consists of RU5 with a Mode-AC doublet, RU6 with a 250 ms offset and a Mode-A singlet, RU1 with a 500 ms offset and a Mode-AC doublet, and RU2 with a 750 ms offset with a Mode-A singlet.

INTERROGATION SCHEDULING

- b) The interrogation rate and power level(s) employed by each transmitter/receiver location
- Interrogation Scheduling

RU	ru4	ru3	ru5	ru6
Offset (60ms)	0	250	500	750
Type	A	AC 175	A	AC 185

Whisper Shout Interrogation Schedule 3

Schedule 3, consists of RU4 with a Mod-A singlet, RU3 with a 250 ms offset and a Mode-AC doublet, RU5 with a 500 ms offset and a Mode-A singlet, and RU6 with a 750 ms offset with a Mode-AC doublet.

GRIFFISS COMPARISON TO CO/ASSC

Remote Unit (version RU5)

Component	FAA CO WAM Baseline	FAA ASSC baseline
Transmitter 1030 MHz	TM2 G1	calibration TM2 G2 (LP) (✓)
Receiver 1090 MHz	EMSD2/ADT (✓)	common EMSD2/ADT (✓)
UAT receiver	N/A	UATR2 (✓)

Target Processor (TP)

Component	FAA CO WAM Baseline	FAA ASSC baseline
MLAT SW		(✓)

Time Synchronization options

GPS (✓)	RefTran	RefTran/GPS
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Note that:

The ASSC baseline is also used for the ASDE-X Tech Refresh which is being deployed across the NAS

The calibration of the TM2 G1 results in max transmit power of 52 dBm vs 50 dBm for the TM2 G2

The (✓) indicates the option used for the Griffiss deployment