

# Taking the "Lost" Out of Lost Communications

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## ABSTRACT

When pilots encounter a loss of two-way radio communications during instrument flight, many situations are not clearly addressed in the regulations. The Federal Aviation Regulations, the Aeronautical Information Manual, the Air Traffic Controller Manual, the Canadian Aeronautical Information Publication, and the Aircraft Owners and Pilots Association Pilot Magazine provide information to aid pilots in decision-making during lost communications situations. There are some circumstances where pilots need additional guidance. The purpose of this paper is to present a review of the literature and input from controllers to provide information for pilots in the event of two-way radio communications failure and to present suggestions for areas of the regulations which could be improved.

## INTRODUCTION

Federal Aviation Administration (FAA) Federal Aviation Regulations (FAR) provide instruction to the pilot regarding what to do in the event of a two-way radio communications failure (lost com) during Instrument Flight Rules (IFR) operations in instrument meteorological conditions (IMC). A detailed study of the specific regulation brings up several questions regarding preflight planning, flight plan information, and expected actions by the pilot in the event of a lost com situation. Although non-regulatory in nature, the Aeronautical Information Manual (AIM) provides information that can assist the pilot in preflight planning to encompass "what if" scenarios involving a lost com. The Air Traffic Control (ATC) Manual details procedures for air traffic controllers to follow and provides insights to pilots regarding controller expectations. In addition, Transport Canada's (TC) Canadian Aeronautical Information Publication (AIP) and the Aircraft Owners and Pilots Association (AOPA) Pilot Magazine provide useful suggestions for pilots who find themselves in a lost com situation.

## LITERATURE REVIEW

### Federal Aviation Regulations

With regard to the route to be flown, 14 CFR 91.185 (c) states that the pilot will fly "(i) by the route assigned in the last ATC clearance received; (ii) if being radar vectored, by the

direct route from the point of radio failure to the fix, route, or airway specified in the vector clearance; (iii) in the absence of an assigned route, by the route ATC has advised may be expected in a further clearance, or (iv) in the absence of an assigned route or a route that ATC has advised may be expected in a further clearance, by the route filed in the flight plan" (FAA, 1990). While there can be little room for doubt of the intent of subparagraphs (i), (iii), and (iv), subparagraph (ii) raises some questions. In a busy terminal area most low altitude traffic is radar vectored. Quite often a pilot will receive radar vectors to the final approach course consisting of a vector opposite to the final approach course and off to one side followed by one or two vectors to position the aircraft to intercept the final approach course outside of the final approach fix. If the pilot is being radar vectored for an instrument approach, the action expected of the pilot will vary depending on where the aircraft is relative to the final approach fix when the lost com occurs and what type of navigation aids are available for the approach.

Another occasion for radar vectors occurs when an aircraft needs to be vectored off course for traffic. 14 CFR 91.185 (c)(1)(ii) (FAA, 1990) does not specify a procedure for lost com while being radar vectored for traffic. Turning back on course might put the lost com aircraft into a potential collision situation. Furthermore, since the events of September 11, a pilot must also be aware if a radar vector course will take the aircraft into a Temporary Flight

Restriction (TFR) area. Penetration into a TFR, especially in a lost com situation, can result in notification to the watch supervisor and possible notification to the military for intercept procedures.

14 CFR 91.185 (c)(2)(ii) states that the pilot will fly "at the highest of the following altitudes or flight levels for the route segment being flown: (i) The altitude or flight level assigned in the last ATC clearance received; (ii) The minimum altitude (converted, if appropriate, to minimum flight level as prescribed in §91.121(c)) for IFR operations; or (iii) The altitude or flight level ATC has advised may be expected in a further clearance" (FAA, 1990). When following subparagraph (ii) the pilot must determine what minimum altitude for IFR operations applies to the current route.

With regard to leaving the clearance limit, subparagraph (i) of 14 CFR 91.185 (c)(3) states, " When the clearance limit is a fix from which an approach begins, commence descent or descent and approach as close as possible to the expect-further-clearance time, if one has been received, or if one has not been received, as close as possible to the estimated time of arrival as calculated from the filed or amended (with ATC) estimated time enroute" (FAA, 1990). In most cases the clearance limit is the destination airport. If the airport has a navigation aid located on the airport and that aid is an initial approach fix, the pilot would be expected to leave that fix at the expect-further-clearance (EFC) time or the estimated time of arrival (ETA), as appropriate. Furthermore, if the pilot has received an amended clearance or a short-range clearance to a fix other than one located at the destination airport and that fix happens to be an initial approach fix for that airport, the pilot is expected to hold at that fix until the EFC time and then proceed with descent and approach.

Subparagraph (ii) of 14 CFR 91.185 (3) states, "If the clearance limit is not a fix from which an approach begins, leave the clearance limit at the expect-further-clearance time if one has been received, or if none has been received, upon arrival over the clearance limit, and proceed to a fix from which an approach begins and commence descent or descent and approach as close as possible to the estimated time of arrival as calculated from the filed or amended

(with ATC) estimated time enroute" (FAA, 1990). If the destination airport is the clearance limit and there are no navigation aids located on the airport, the pilot cannot get to the clearance limit without first executing the approach, making it impossible to comply with the regulation.

The requirement to hold until the ETA in the absence of an EFC leads to the question of how the estimated time enroute (ETE) is determined. The FAR list the information required on a Visual Flight Rules (VFR) flight plan. 14 CFR 91.153 (a)(6) instructs the pilot to file to "the point of first intended landing and the estimated elapsed time until over that point" (FAA, 1963). 14 CFR 91.169(a)(1) instructs the pilot filing an IFR flight plan to include the "information required under 91.153(a)" and differs from 14 CFR 91.153 only by the requirement to file for an alternate under certain weather conditions (FAA, 2000). The Pilot/Controller Glossary defines ETE as "the estimated flying time from departure point to destination (lift-off to touchdown)" (FAA, 2002a). Therefore, the ETE must include the time estimated for performing the approach procedure. Since 14 CFR 91.185 (c)(3) prevents the pilot from beginning the approach until the ETA, a pilot operating under a lost com situation will not arrive at the airport at the ETA (FAA, 1990). This could impact fuel reserves, especially if a pilot has to execute a missed approach and proceed to the alternate.

### **Aeronautical Information Manual**

The AIM, Chapter 6, Section 4, Paragraph 1, Subparagraph (a) states, "It is virtually impossible to provide regulations and procedures applicable to all possible situations associated with two-way radio communications failure. During two-way radio communications failure, when confronted by a situation not covered in the regulation, pilots are expected to exercise good judgment in whatever action they elect to take. Should the situation so dictate they should not be reluctant to use the emergency action contained in 14 CFR Section 91.3 (b)" (FAA, 2002a). 14 CFR 91.3 allows the pilot to deviate from any rule under § 91 to meet the needs of an emergency (FAA, 1963). While this

allows the pilot to exercise his/her judgment for situations not covered by the FAR, the pilot should be aware of what ATC might expect and that it will require ATC some time to clear other traffic out of the way.

The AIM, Chapter 5, Section 1, Paragraph 7, Subparagraph (f) (FAA, 2002a) provides explanations of IFR flight plan items. It instructs the pilot to enter the estimated time enroute based on latest forecast winds into block 10 of the flight plan form. This subparagraph also instructs the pilot to "specify an alternate airport if desired or required, but do not include routing to the alternate airport" (FAA, 2002a). Subparagraph (g) states, "The information transmitted to the ARTCC [Air Route Traffic Control Center] for IFR flight plans will consist of only flight plan blocks 2, 3, 4, 5, 6, 7, 8, 9, 10, and 11" (FAA, 2002a). The block for listing an alternate is block 13. In the event a lost com pilot must execute a missed approach, the ARTCC must contact the Flight Service Station (FSS) to ascertain the alternate. Furthermore, the ARTCC would not know what route the pilot might use.

The Pilot/Controller Glossary defines "minimum IFR altitudes". In paragraph (c) the Glossary includes altitudes "as otherwise authorized by the Administrator or assigned by ATC (Air Traffic Control). (See Minimum Enroute IFR Altitude) (See Minimum Obstruction Clearance Altitude) (See Minimum Crossing Altitude) (See Minimum Safe Altitude) (See Minimum Vectoring Altitude)" (FAA, 2002a). The AIM, Chapter 6, Section 4, Paragraph 1, Subparagraph 3, Note states "The intent of the rule is that a pilot who has experienced two-way radio failure should select the appropriate altitude for the particular route segment being flown and make the necessary altitude adjustments for subsequent route segments" (FAA, 2002a). The minimum altitude for IFR operations is determined by the location of the aircraft. If the aircraft is within 22 nautical miles of a Very High Frequency Omnidirectional Range (VOR) station on an airway for which a Minimum Obstruction Clearance Altitude (MOCA) is prescribed, the MOCA can be used as the minimum altitude. If the pilot is within 25 nautical miles of the facility or fix designated for Minimum Safe

Altitude (MSA) sectors, the MSA may be used as the minimum altitude. While these altitudes might be the minimum IFR altitude for the location of the aircraft, the pilot must still comply with 14 CFR 91.185 (c)(2) (FAA, 1990). There is an additional minimum altitude which is included in the Pilot/Controller glossary definition but which is not printed on aeronautical charts. Controllers routinely assign altitudes down to the minimum vectoring altitude (MVA). Although clearance down to an MVA might meet both the requirement for last assigned altitude and for minimum IFR altitude as defined by the Pilot/Controller glossary, the pilot does not have any definitive method to determine the boundaries of the MVA.

The Pilot/Controller Glossary defines ETA as "the time the flight is estimated to arrive at the gate (scheduled operators) or the actual runway on times for non-scheduled operators" (FAA, 2002a). This verifies that in a lost com situation the pilot should not expect to touch down at the filed ETA; the touch down time would be the ETA plus the time to execute the approach.

## **Air Traffic Control Manual**

The Air Traffic Control Manual (FAA Order 7110.65N) outlines procedures for air traffic controllers to follow in the event of two-way radio communications failure with an aircraft under ATC control. Chapter 10, Section 4-4 states "when an IFR aircraft experiences two-way radio communications failure, air traffic control is based on anticipated pilot actions" (FAA, 2002b). Such actions are based on procedures and recommended practices from the FAR and AIM. This includes the expectation that the pilot will squawk code 7600 on the transponder. Chapter 10, Section 4-4 directs controllers to attempt to contact the aircraft by all available means including emergency frequencies (121.5 Megahertz) and VORs with voice capability (FAA, 2002b). Controllers are instructed to direct the lost com aircraft to respond by alternate methods. These methods include squawking ident, changing to code 7600 if the aircraft is not already squawking that code, or turning the transponder to stand-by for a specified period of time and then returning to the

assigned code. If the pilot responds with the requested transponder action the controller will give additional instructions and monitor radar to check for compliance. The manual also directs controllers to "broadcast a clearance for the aircraft to proceed to its filed alternate airport at the MEA if the aircraft operator concurs" (FAA, 2002b). Operator concurrence implies some sort of response from the pilot, i.e. transponder input.

### **Canadian Aeronautical Information Publication**

The Canadian AIP (TC, 1999) reminds pilots of common sense procedures which might be forgotten in the heat of the situation. AIP RAC 6.3.2.1 informs the pilot to maintain a listening watch on the appropriate frequencies and to acknowledge receipt of any messages in any manner the pilot can devise (TC, 1999). AIP RAC 6.3.2.2 also tells pilots to try to contact anyone, including other air traffic controllers or pilots, to relay information (TC, 1999). If lost com pilots find themselves in visual meteorological conditions (VMC) the AIP clarifies that the requirement to land as soon as practicable does not imply to land as soon as possible, i.e. on an airport not suitable for the type of aircraft.

AIP RAC 6.3.2(b)(ii) provides information regarding loss of communications while operating at an MVA. The corresponding note 2 states that "if the failure occurs while being vectored at a radar vectoring altitude which is lower than a published IFR altitude, then the pilot shall immediately climb to and maintain the appropriate minimum IFR altitude until arrival at the fix, route or airway specified in the clearance" (TC, 1999).

The AIP provides suggestions for pilots experiencing lost com who have other onboard communications technology such as a cellular phone. Pilots can use such devices to contact ATC either directly or through a Flight Service Station (TC, 1999).

### **Aircraft Owners and Pilots Association**

The AOPA website provides several articles from AOPA Magazine regarding lost com situations. A troubleshooting guide to

determine the extent of the problem is provided by Cook (1998). The possibilities include: being temporarily out of range of the ATC facility (especially while operating at minimum altitudes in mountainous areas), failure of only one radio when a second is operational, improper selection of the audio panel, failure of only the transmit capability or only the receiver capability, and problems with headsets or intercoms. Cook advocates carrying a portable transceiver for situations where troubleshooting does not solve the problem. He offers suggestions for improving the limitations of hand held devices, such as carrying extra batteries, an external antenna, and a headset adapter. In addition, he reminds pilots to carry a spare microphone and headset. He also suggests carrying a portable global positioning system (GPS) to assist in planning a course of action if VMC is encountered. Finally, he warns that failure of the alternator is one of the most common causes of radio communications failures. If the pilot determines that the alternator has failed the pilot will need to load shed to conserve battery power and determine the best course of action to terminate the flight prior to total electrical failure.

Cook also provides information regarding use of the transponder (Cook, 1998). After ascertaining that a lost com situation exists, he recommends squawking 7600 for one minute then returning to the assigned code. He also recommends squawking 1200 in the event the pilot encounters VMC and is able to proceed under visual flight rules (VFR). The pilot should then notify ATC as soon as possible that IFR is being cancelled. If communications cannot be re-established in flight this would require notification on the ground.

Cook discusses altitude selection following a change in minimum enroute altitude (MEA). He states that if a pilot has climbed to comply with a route segment with a higher MEA than the last assigned altitude "it doesn't really matter" if the pilot chooses to stay at that altitude after the MEA goes down "as long as your transponder is working" (Cook, 1998, para. 15). He warns that the pilot must consider the type of airspace and what effect "remaining at the non-assigned altitude" (Cook, 1998, para. 15) will have on ATC.

With regard to arriving at the clearance limit early, Cook states that "controllers we know say that they would prefer that you begin the approach when you arrive at the fix" (Cook, 1998, para. 16) rather than entering a hold.

Another AOPA Pilot Magazine article also provided suggestions, some of which contradicted suggestions from the other article. In addition to the troubleshooting guide provided by Cook, Marsh (1999) also advises tuning in a nearby voice-capable VOR and listening on that frequency. He states that pilots will often select the wrong frequency when being handed off to another controller and that communications can often be re-established by simply re-contacting the previous controller.

Marsh contradicts Cook regarding transponder squawk codes to be used during lost com. Marsh advises leaving the transponder on code 7600 and states that "nothing in the data block on the controller's radar screen will change, including your N number, if you start squawking 7600 instead of the assigned code" (Marsh, 1999, para. 6).

Marsh states that controllers anticipate "that you will do what you said you would do, and at the time you said you would do it" (Marsh, 1999, para. 7). This implies strict adherence to the altitudes, routes, and times specified in 14 CFR 91.185 (FAA, 1990).

## **DISCUSSION**

### **RADAR VECTORS**

J. T. Moore, Airspace and Procedures Manager of the Seattle ARTCC provided information regarding what ATC would expect a pilot to do in the event of a lost com during radar vectors to an Instrument Landing System (ILS) approach (J. T. Moore, personal communication, January 10, 2003). Moore used the Bremerton National Airport ILS Runway (Rwy) 19 instrument approach procedure (U.S. Department of Transportation, 2001) as an example (see figure 1). He stated that if a pilot were on a downwind vector and had not passed the Initial Approach Fix (IAF) at Checo (a fan marker only), he would expect the pilot to proceed direct to the Kitsap non-directional beacon (NDB) and then proceed outbound for

procedure turn. If the pilot had passed Checo (which could be determined by passage of the 279 degree radial of the Seattle VOR), he would expect the pilot to turn to intercept the localizer course and proceed inbound on the approach.

Peter Roberts, a Certified Professional Controller with the Seattle ARTCC and an instrument rated pilot, warned that pilots must be cautious when given radar vectors in the vicinity of TFRs. If a vector points to a TFR the controller should inform the pilot what to do in the event of no communication within a specified time period. He stated that if a pilot does not hear this instruction the pilot should query the controller. (P. Roberts, personal communication, January 10, 2003).

### **ALTITUDE**

14 CFR 91.185 (c)(2) requires the pilot to stay at the last assigned altitude, the minimum altitude for IFR operations, or the altitude prescribed in an EFC (whichever is higher) (FAA, 1990). The Pilot/Controller Glossary broadens the definition of Minimum IFR Altitude to include MOCAs, MSAs, and MVAs. Lisa Foulk, an Airspace and Procedures Specialist with the Seattle ARTCC, stated that in a lost com situation, controllers don't know what other emergency situations the pilot might be experiencing. Controllers will attempt to clear all traffic out from beneath a lost com aircraft in the event the pilot might need to descend under the authority granted by 14 CFR 91.3 (L. Foulk, personal communication, January 10, 2003). However, Foulk stated that in most of the lost com situations she was familiar with the pilots elected to stay at the higher enroute altitudes until the ETA (L. Foulk, personal communication, January 10, 2003).

### **LEAVING THE CLEARANCE LIMIT**

During preflight planning the pilot can clarify the routing to limit confusion in the event of a lost com. Using the Bremerton National Airport ILS Runway 19 instrument approach procedure (U.S. Department of Transportation, 2001) as an example, a pilot arriving from the south via Victor Airway V165 could list the routing to the destination airport as follows:

V165, Carro, direct Carney NDB, direct Kitsap NDB, direct Checo (see figure 1). In the event of a lost com after takeoff there would be no doubt in the pilot's mind or at ATC about the intended route of flight. If the clearance limit is the airport the pilot would proceed from the Kitsap NDB to the initial approach fix at Checo. If Checo is reached prior to the ETA the pilot is expected to hold at Checo on the localizer course until the ETA and then execute the procedure turn and approach (see figure 1).

### **ESTIMATED TIME ENROUTE**

The Pilot/Controller Glossary is clear on the definition of ETE (FAA, 2002a). The pilot should include the estimated time for executing an instrument approach in the ETE. When contemplating fuel requirements the pilot should be aware that in the event of a lost com the approach cannot commence until the estimated touch down time. The pilot should calculate the ETE as accurately as possible to avoid the possibility of excessive time in a holding pattern. The specific routing to an IAF may help the pilot arrive at a more accurate ETE.

### **MISSED APPROACH**

The AIM (Chapter 5, Section 1, Paragraph 7, Subparagraph (g) states that blocks 2 through 11 will be transmitted to the ARTCC for IFR flight plans (FAA, 2002a). Although the block for an alternate airport is not included in the above blocks, block 11 (the section for remarks) is. Tim Knight, Airspace and Procedures Specialist at the Seattle ARTCC, stated that anything placed in the remarks section of an IFR flight plan is transmitted to the ARTCC (T. Knight, personal communication, January 17, 2003). He stated that if a pilot lists in the remarks block the name of the alternate airport and the route and altitude to be used to get to the alternate airport, this information will be transmitted to the ARTCC and will appear on the data strip for the aircraft. Without this information ARTCC has no definitive method to predict the route to the alternate. According to the Air Traffic Control Manual the controller should transmit a clearance to the alternate at the MEA (FAA, 2002b). Operation at the MEA

might put a pilot into icing conditions or high fuel burn situations. By listing the desired altitude in the remarks section the pilot can advise ATC of the intended altitude should a lost com situation arise.

### **TRANSPONDERS**

Cook (1998) advocates changing the squawk code to 1200 if VMC conditions are encountered and the pilot is able to maintain VFR to a landing. Resetting the transponder to 1200 risks removing the data block attached to the target, causing the target to blend in with other 1200 squawk codes. Setting the transponder to 7600 and leaving it there until landing will keep the data block attached to the radar target but does not inform the controller that the pilot is operating under VFR.

The Air Traffic Control Manual refers to the expectation that the lost com aircraft will squawk 7600 (FAA, 2002b). Setting any other code into the transponder (except when directed by ATC when the pilot is able to receive but not transmit) contradicts the expectations outlined in the Air Traffic Control Manual.

Pilots should be cautious of assuming that a transponder reply light implies that they are in radar contact. The reply light can be activated by an interrogation from a traffic collision avoidance system (TCAS) or from a radar site other than the one in use by the air traffic controller handling the flight.

### **CONCLUSION**

Careful preflight planning on the ground can make a lost com situation less stressful for the pilot and for controllers. Listing exact routing, including transition routes and the intended IAF, on the flight plan under route of flight will eliminate confusion if the pilot has to resort to the flight plan route. This exact routing will also allow the pilot to compute an accurate ETE which should include the time to execute the approach. Unfortunately, unless the FAA revises 14 CFR 91.185 (c)(3) (FAA, 1990), a lost com pilot will have to hold over the IAF for the time allotted for executing the approach. Fuel requirements for the flight should consider the possibility of this extra time.

An immediate remedy is available to eliminate confusion regarding the intended route and altitude to be flown to the alternate. The inclusion in the remarks block of the instrument flight plan the name of the alternate airport and the route and altitude to be flown to the alternate provides assurance that ATC will know the pilot's intentions. The inclusion of the altitude to the alternate will insure that the pilot can fly the route at an altitude suitable for the type of aircraft and the forecast weather conditions.

Troubleshooting prior to assuming a lost com situation exists can often eliminate the problem. In addition to the suggestions provided in the AOPA articles the pilot might be able to solve a stuck microphone problem by using the external position or off position on the transmitter selector switch to alternate between receive and transmit.

Pilots should be aware of their exact position at all times while being radar vectored. Should the radio go silent during radar vectors to a final approach course the pilot will be able to decide how best to intercept the course. Awareness of proximity to TFRs and coordination with ATC if vectored toward one can prevent a lost com problem from also becoming an intercept situation.

Due to confusion regarding squawk codes an Advisory Circular or clarification in the AIM should be considered. The FAA should address what squawk code or codes are to be utilized if the pilot encounters VMC and will continue under VFR.

Handheld radios and cellular phones provide pilots with a means of contacting ATC during a lost com. Care should be taken to insure that these items have fully charged batteries and that external antennas, microphones and headsets will operate properly if needed.

Even with on-board back-ups pilots should not adopt a cavalier attitude about lost com. The AIM lists information about lost com procedures under the emergency procedures section, and a pilot must evaluate each situation to see if it constitutes an emergency (FAA, 2002a). An occasional review of 14 CFR 91.185 (FAA, 1990) and the AIM (FAA, 2002a) will benefit the pilot should the situation arise.

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Figure 1. Bremerton National Airport, ILS RWY 19 Approach Procedure (U.S. Department of Transportation (2001).

