

NATIONAL TRANSPORTATION SAFETY BOARD

Office of Research and Engineering *gar*
Washington, D.C. 20594

February 19, 2002

Flight Path Study - United Airlines Flight 93

A. SUBJECT AIRCRAFT

Location: Shanksville, PA
Date: September 11, 2001
Time: 10:03 AM Eastern Daylight Time
Flight: United Airlines Flight 93
Aircraft: Boeing 757-200, registration: N591UA
NTSB#: DCA01MA065

B. GROUP

N/A

C. SUMMARY

This document provides a brief description of the flight path of the aircraft based on information obtained from various sources of recorded radar of the subject aircraft both before and after the hijacking events. Information from the Flight Data Recorder (FDR) recovered on scene is also used to develop the description. Flight paths are overlaid onto maps of the area, and time histories of altitude data are presented

United Airlines Flight 93 – Flight Profile

The following profile of United Airlines Flight 93 is based on data from the flight data recorder (FDR) recovered from the crash site, as well as radar data obtained from the Federal Aviation Administration's Air Route Traffic Control Centers and the U.S. Air Force 84th Radar Evaluation Squadron.

Figure 1 shows the flight path of the aircraft from take off at Newark, NJ to the crash site near Johnstown, PA. Figure 2 shows the aircraft's altitude profile for the 1 hour and 21 minute duration of the flight.

United flight 93 departed Newark, NJ at 8:42 am (point A in Figures 1 and 2) and reached its assigned cruising altitude of 35,000 feet at about 9:02 am (B). The flight appears normal until a brief descent of about 600 feet starting at 9:28 (C). The words "get out of here" and sounds of a struggle were recorded on the air traffic control radio at FAA's Cleveland Center facility at this time. The Cockpit Voice Recorder (CVR) onboard the airplane began providing sounds from the cockpit at approximately 9:32. At 9:34 (D) the airplane starts to climb from 35,000 feet, and shortly thereafter begins a left turn to a Southeast heading of 120° with the autopilot in heading select mode. The airplane maintained a maximum altitude of 41,000 feet for about 2 minutes and then started descending at about 9:39 (E), with the autopilot in vertical speed mode and at a descent rate of 4,000 feet/minute. Radar stations stopped receiving transponder returns from UAL93 at approximately 9:41.

There was a brief interruption in the descent at 9:46 (F) as the airplane climbed from 19,000 feet to 20,500 feet before resuming its descent, but at a slower rate (1,300 feet/minute). At about 9:57 the airplane started a left turn to the east. At 9:59 (G) the airplane was at 5,000 feet when about 2 minutes of rapid, full left and right control wheel inputs resulted in multiple 30 degree rolls to the left and right. From approximately 10:00 to 10:02 there were four distinct control column inputs that caused the airplane to pitch nose-up (climb) and nose-down (dive) aggressively. During this time the airplane climbed to about 10,000 feet while turning to the right. The airplane then pitched nose-down and rolled to the right in response to flight control inputs, and impacted the ground at about 490 knots (563 mph) in a 40 degree nose-down, inverted attitude. The time of impact was 10:03:11.


Jim Ritter
Chief, Vehicle Performance Division
NTSB

Figure 1. UA-93 Radar Ground Track

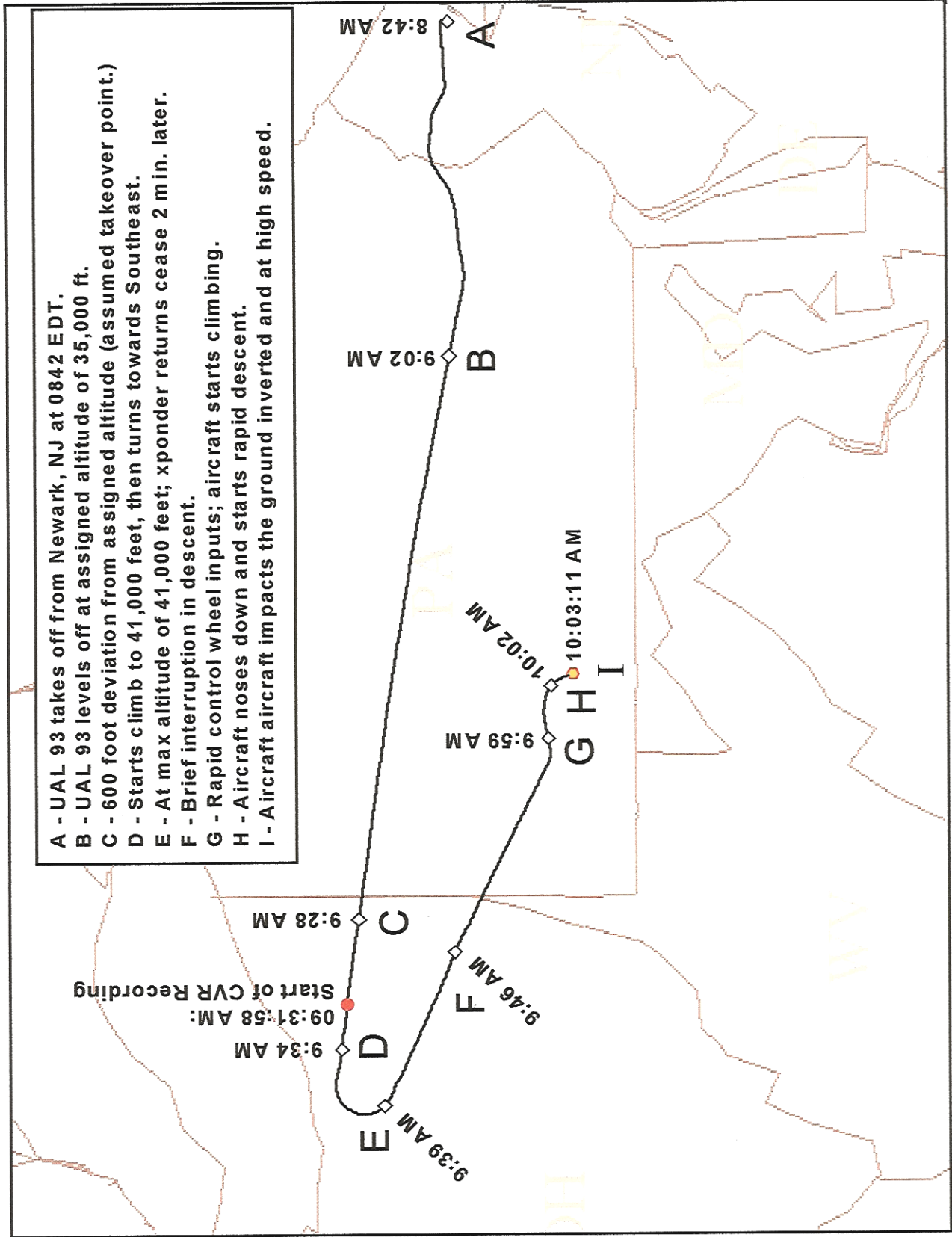
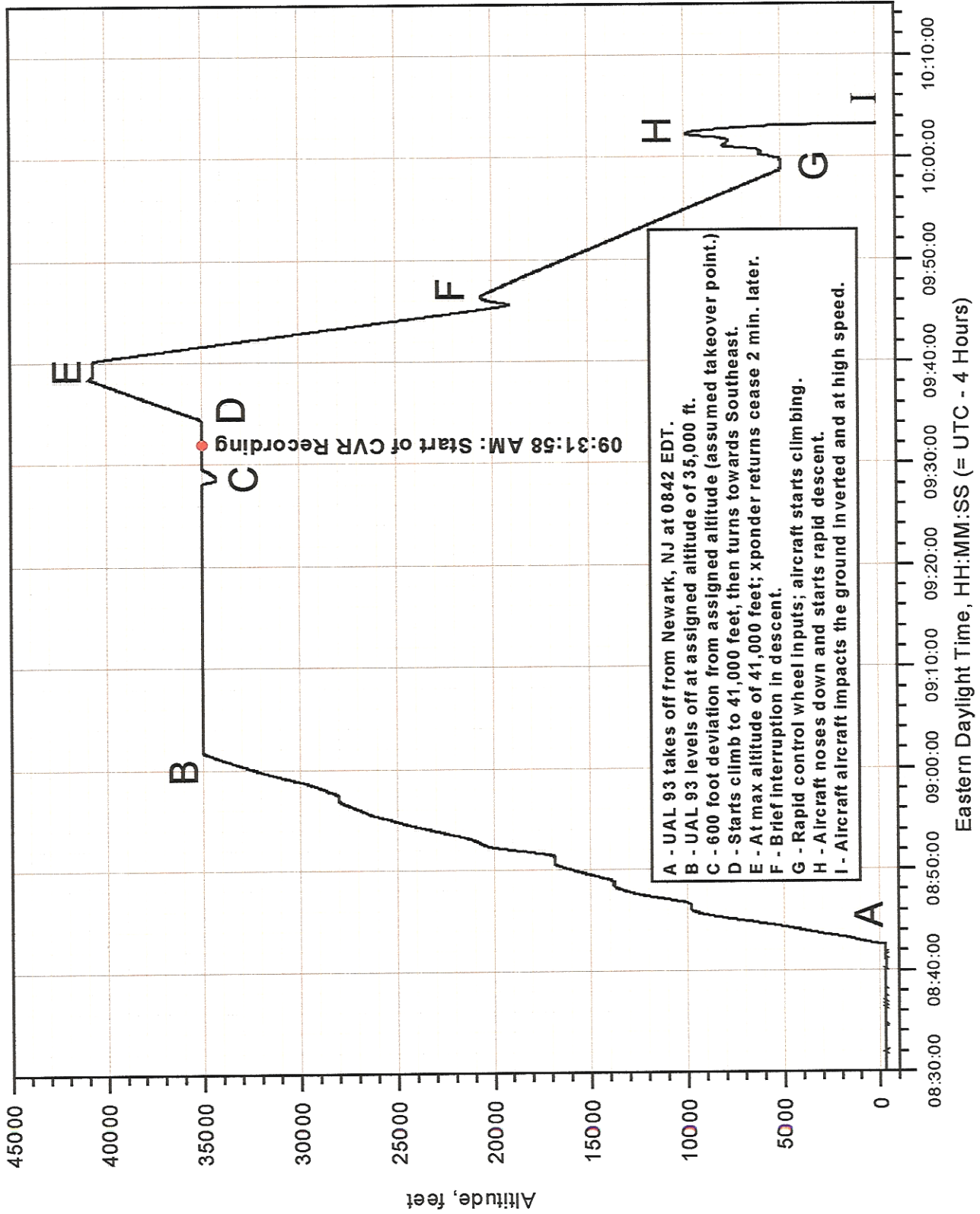


Figure 2. UA-93 Altitude Profile



8:41:49 LC United ninety three wind three three zero at seven runway four left cleared for takeoff. [EWR 1235-1247 LC]

8:41:53 UAL-93 cleared takeoff four left United ninety three. [EWR 1235-1247 LC]

8:42:07 LC United ninety three. [EWR 1235-1247 LC]

8:42:41 LC United ninety three contact departure. [EWR 1235-1247 LC]

8:42:43 UAL-93 going to departure United ninety three good day. [EWR 1235-1247 LC]

8:43:00 UAL-93 United ninety three fourteen hundred for twenty five hundred. [N90 1238-1256 Newark Dept.]

8:43:04 E155 United ninety three New York departure good morning radar contact climb and maintain eight thousand and turn left heading three three zero vector for ELIOT. [N90 1238-1256 Newark Dept.]

8:43:12 UAL-93 eight thousand heading three three zero for ELIOT United ninety three. [N90 1238-1256 Newark Dept.]

8:43:48 E155 United ninety three turn left heading uh two eight zero. [N90 1238-1256 Newark Dept.]

8:43:52 UAL-93 left two eighty United ninety three. [N90 1238-1256 Newark Dept.]

8:44:34 E155 United ninety three climb and maintain one zero thousand. [N90 1238-1256 Newark Dept.]

8:44:38 UAL-93 climb and maintain one zero thousand ten thousand United ninety three. [N90 1238-1256 Newark Dept.]

8:45:10 E155 United ninety three do not exceed two five zero knots. [N90 1238-1256 Newark Dept.]

8:45:13 UAL-93 not exceed two fifty United ninety three. [N90 1238-1256 Newark Dept.]

8:45:54 E155 United ninety three resume normal speed contact departure one three five point three five. [N90 1238-1256 Newark Dept.]

8:46:00 UAL-93 one three five three five normal speed good day United ninety three. [N90 1238-1256 Newark Dept.]

8:46:18 UAL-93 United ninety three is with you one zero thousand, normal speed, heading two eighty. [N90 1238-1256 Liberty West]

8:46:23 B43 United ninety three departure good morning, climb maintain one four thousand. [N90 1238-1256 Liberty West]

8:46:26 UAL-93 climb maintain one four thousand United ninety three. [N90 1238-1256 Liberty West]

8:48:03 B43 United ninety three right turn heading of ah three one zero. [N90 1238-1256 Liberty West]

8:48:07 UAL-93 right heading three one zero United ninety three. [N90 1238-1256 Liberty West]

8:48:41 B43 United ninety three climb maintain one six thousand. [N90 1238-1256 Liberty West]

8:48:44 UAL-93 climb maintain one six thousand United ninety three. [N90 1238-1256 Liberty West]

8:49:31 B43 United ninety three climb maintain one seven thousand go direct ELIOT on course. [N90 1238-1256 Liberty West]

8:49:35 UAL-93 up to one seven thousand direct ELIOT United ninety three. [N90 1238-1256 Liberty West]

8:50:37 B43 United ninety three contact New York center one three two point one good day. [N90 1238-1256 Liberty West]

8:50:41 UAL-93 thirty two one good day United ninety three. [N90 1238-1256 Liberty West]

8:50:57 UAL-93 and New York United ninety three with you one seven thousand. [ZNY 1245-1258 R39]

8:51:03 R39 United ninety three New York center climb and maintain flight level two eight zero. [ZNY 1245-1258 R39]

8:51:07 UAL-93 maintain two eight oh United ninety three. [ZNY 1245-1258 R39]

8:54:09 R39 United ninety three cleared direct DEMO. [ZNY 1245-1258 R39]

8:54:12 UAL-93 direct DEMO United ninety three. [ZNY 1245-1258 R39]

8:54:53 R39 United ninety three contact New York center one three three point four correction New York center one thirty two eighty seven. [ZNY 1245-1258 R39]

8:54:59 UAL-93 one thirty two eighty seven good day United uh ninety three. [ZNY 1245-1258 R39]

8:55:05 UAL-93 good morning New York United ninety three with you twenty five and a half for two eight oh. [ZNY 1250-1328 R73]

8:55:09 R73 United ninety three New York center good morning. [ZNY 1250-1328 R73]

8:57:12 R73 United ninety three climb and maintain flight level three five zero. [ZNY 1250-1328 R73]

8:57:16 UAL-93 leaving two eight for three five oh United ninety three. [ZNY 1250-1328 R73]

9:22:20 UAL-93 United ninety three starting to pick up some light chop at thirty five, any ride reports? [ZNY 1308-1328 RA73]

9:22:26 RA73 the ah first complained I've had and United ah ninety three, contact the Cleveland center now on one three three point zero seven. [ZNY 1308-1328 RA73]

9:22:37 UAL-93 thirty three oh seven United ninety three. [ZNY 1308-1328 RA73]

9:23:00 ACARS BEWARE ANY COCKPIT INTROUSION. . TWO AIRCRAFT IN NY, HIT TRADE CNTER BUILDS

9:23:05 UAL-93 morning Cleveland it's United ninety three with you at three five oh ah there's some light chop here at thirty five any ride reports? [ZOB 13:01-13:31 Franklin-R]

9:23:14 FKL-R an no just a little light chop nothing worse than that United ninety three. [ZOB 13:01-13:31 Franklin-R]

9:23:56 FKL-R United ninety three Cleveland one three three three seven. [ZOB 1301-1331 Franklin-R]

9:24:00 UAL-93 one three three three seven good day United ninety three. [ZOB 1301-1331 Franklin-R]

9:24:20 UAL-93 good morning Cleveland United ninety three is with you at three five oh intermittent light chop. [ZOB 1314-1333 Lorain-R]

9:25:06 UAL-93 United ninety three checking in three five oh. [ZOB 1314-1333 Lorain-R]

9:25:08 LOR-R United ninety three three five zero roger. [ZOB 1314-1333 Lorain-R]

9:27:25 LOR-R United ninety three that traffic for you is one o'clock twelve miles east bound three seven zero. [ZOB 1314-1333 Lorain-R]

9:27:30 UAL-93 negative contact we're looking United ninety three. [ZOB 1314-1333 Lorain-R]

9:28:16 UAL-93 *** (mayday) *** (hey get out of here) ***. [ZOB 1314-1333 Lorain-R]

9:28:48 UAL-93 *** (get out of here) *** (get out of here). [ZOB 1314-1333 Lorain-R]

9:29:14 LOR-R United ninety three verify three five zero. [ZOB 1314-1333 Lorain-R]

9:29:20 LOR-R United ninety three verify you're at flight level ah three five zero. [ZOB 1314-1333 Lorain-R]

9:29:34 LOR-R United ninety three verify you're level at three five zero. [ZOB 1314-1333 Lorain-R]

9:29:40 LOR-R United ninety three Cleveland. [ZOB 1314-1333 Lorain-R]

9:29:56 LOR-R United ninety three Cleveland. [ZOB 1314-1333 Lorain-R]

9:30:03 LOR-R United ninety three if you hear Cleveland center ident please. [ZOB 1314-1333 Lorain-R]

9:30:58 LOR-R United ninety three Cleveland if you hear the center ident. [ZOB 1314-1333 Lorain-R]

9:31:55 UAL-93 *** please sit down. keep remaining seating. we have a bomb on board. so ***. [ZOB 1314-1333 Lorain-R]

9:32:05 LOR-R er uh calling Cleveland center you're unreadable say again slowly. [ZOB 1314-1333 Lorain-R]

9:35:36 LOR-R ah United ninety three if able * ah squawk trip please. [ZOB 1333-1344

Lorain-R]

9:36:51 LOR-R [Cleveland center announces that UAL93 is turning south and east and climbing]. [ZOB 1333-1344 Lorain-R]

9:39:10 UAL-93 ah this is the captain uh would like to all remain seated there is a bomb aboard and we go back to the airport and to have our demands so please remain quiet. [ZOB 1333-1344 Lorain-R]

9:39:19 LOR-R okay thats United ninety three calling? [ZOB 1333-1344 Lorain-R]

9:39:24 LOR-R United ninety three understand you have a bomb on board go ahead. [ZOB 1333-1344 Lorain-R]

9:40:04 LOR-R United ninety three go ahead. [ZOB 1333-1344 Lorain-R]

9:40:12 LOR-R United ninety three go ahead. [ZOB 1333-1344 Lorain-R]

9:41:01 LOR-R United ninety three do you hear Cleveland center? [ZOB 1333-1344 Lorain-R]

9:41:36 LOR-R [Cleveland center announces loss of transponder signal from UAL93] [ZOB 1333-1344 Lorain-R]

9:45:29 LOR-R United ninety three Cleveland do you still hear the center? [ZOB 1344-1400 Lorain-R]

9:45:35 LOR-R United ninety three do you still hear Cleveland? [ZOB 1344-1400 Lorain-R]

9:46:13 LOR-R United ninety three United niner three do you hear Cleveland? [ZOB 1344-1400 Lorain-R]

9:47:28 LOR-R United ninety three United ninety three Cleveland. [ZOB 1344-1400 Lorain-R]

9:48:39 LOR-R United ninety three United ninety three do you hear Cleveland center. [ZOB 1344-1400 Lorain-R]