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FLIGHT DATA TRACKER SYSTEM

Introduction

Air France Flight 447 crashed in 2009 into Atlantic ocean. Black box was found two years later at a cost of $40 million

Introduction

Malaysian Airlines Flight MH370 disappeared on March 8, 2014 and could not be found. A massive search operation was launched by 26 countries.

Introduction

- There is a real problem in international aviation.
- Some international flights are not being tracked in real-time!! (In North America and Europe, ADS-B based tracking is increasingly being adopted)
- The vital flight data and audio are preserved in a box that is lost on crash and requires considerable effort to find.

Market

- Existing approaches
  - Black box data is recovered after crash. It is an expensive and time consuming operation
  - Audio data is protected by Pilots' unions
  - Occasionally the flight data may be transferred real-time using ARINC protocols in ACARS
  - SWIFT data for AirFrance flight 447 was not enough and $40 million were spent on finding the black box. It took 2 years to find it.
  - The online black box idea is considered too expensive, but the cost can be reduced.

Market

- Where could a new solution fit in?
- Airlines, plane and Blackbox manufacturers need flight data in real-time on the ground
- This data can be used to prevent mishaps by alerts in real-time and save money and time on black box search after a crash. (Intense computations possible on ground based servers!!)
- Aviation is global; need a pilot project
- Solution should integrate well with ACARS

Proposed solution (technology)

- Basic overview of invention / concept
- The real-time distributed flight data tracker is a great improvement over dispatching teams to find black box after a crash
- It could prevent crashes by alerting pilots of unsafe conditions before the mishap and detect deviations from the route.
- Currently the main algorithms are completed and a proof of concept software in C language is functional on simulated servers

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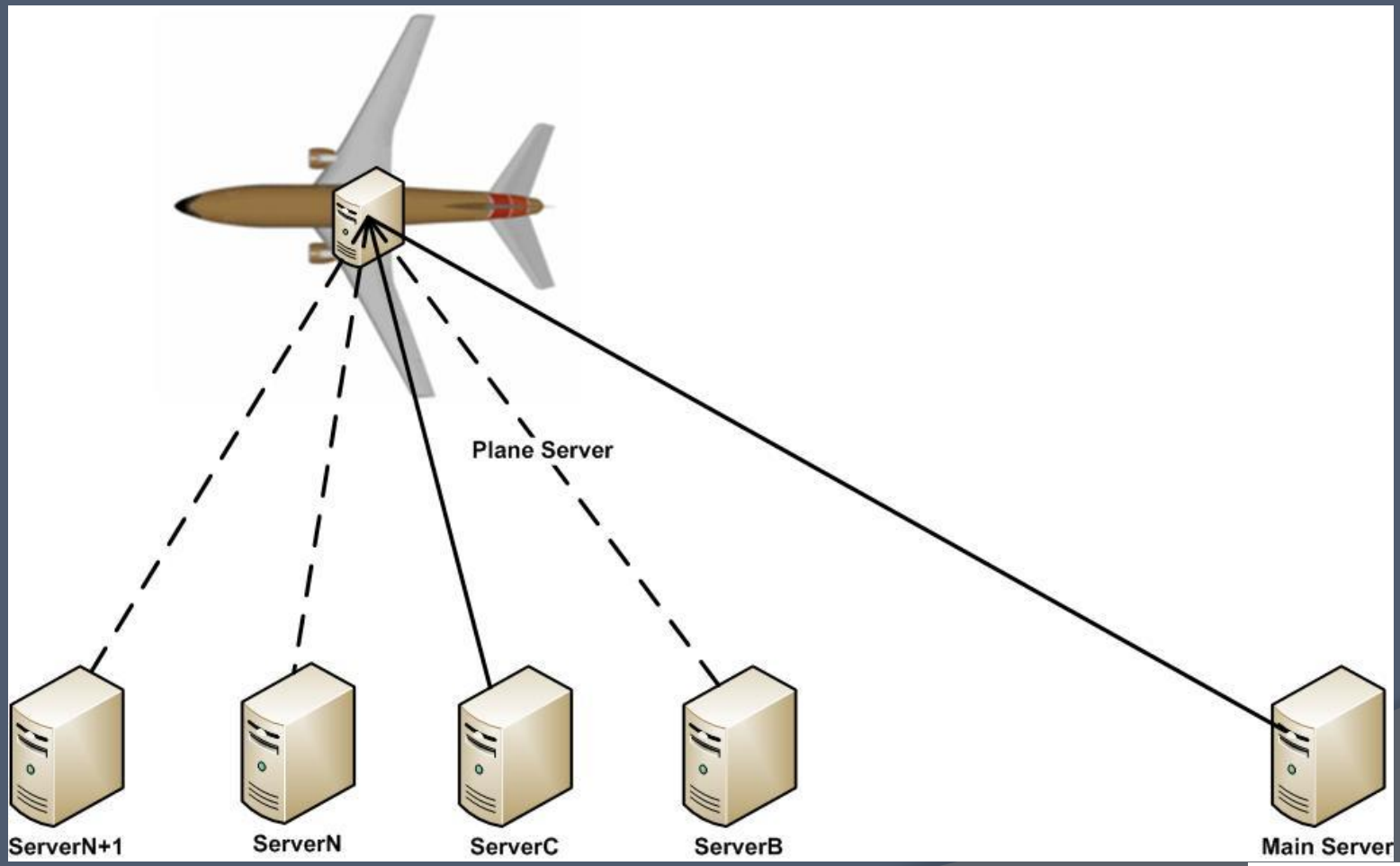
Distributed Flight Data Transmission



Distributed Flight Data Transmission

- Three types of servers
  - Main server is at the origin airport control tower of the flight. It initializes the flight parameters
  - Plane server is on the aircraft as part of ACARS for which the flight data is being recorded
  - In addition, there is an array of distributed servers strategically located until the final destination of the flight, contacted by plane using UHF or satellite

The Cost

- We ran a study on 88 parameters mandated for storage in the black box
- The average bandwidth required is 1.8kbps however some variations are possible when large amount of data may be transferred in short time
- The data can be compressed and encrypted
- If using satellite communication, data can be sent 1-of-N times
- Deviation from route detection is under development (could use ADS-B data)

Intellectual Property

- Any Existing IP?
- Filed non-provisional patent application in January 2014
- Is there Freedom to Operate?
- Algorithms can be obtained from publication in IEEE Digital Library
- Version 5.0 implements data transfer from the plane to main and distributed servers, utilizes flight routing and fault tolerance

Demo

- On the next slide, a demo of the software is shown. Six servers are started up and data server-2 is shut down
- The main and plane servers exchange control messages as shown. The flight routing is done by the main server considering the waypoints and airports between origin and destination
- The flight progresses smoothly, switching from data server-2 to the next one on the route
- “Flight end” control message activates data transfer to the main server. Each flight’s main server is located at the origin of the flight

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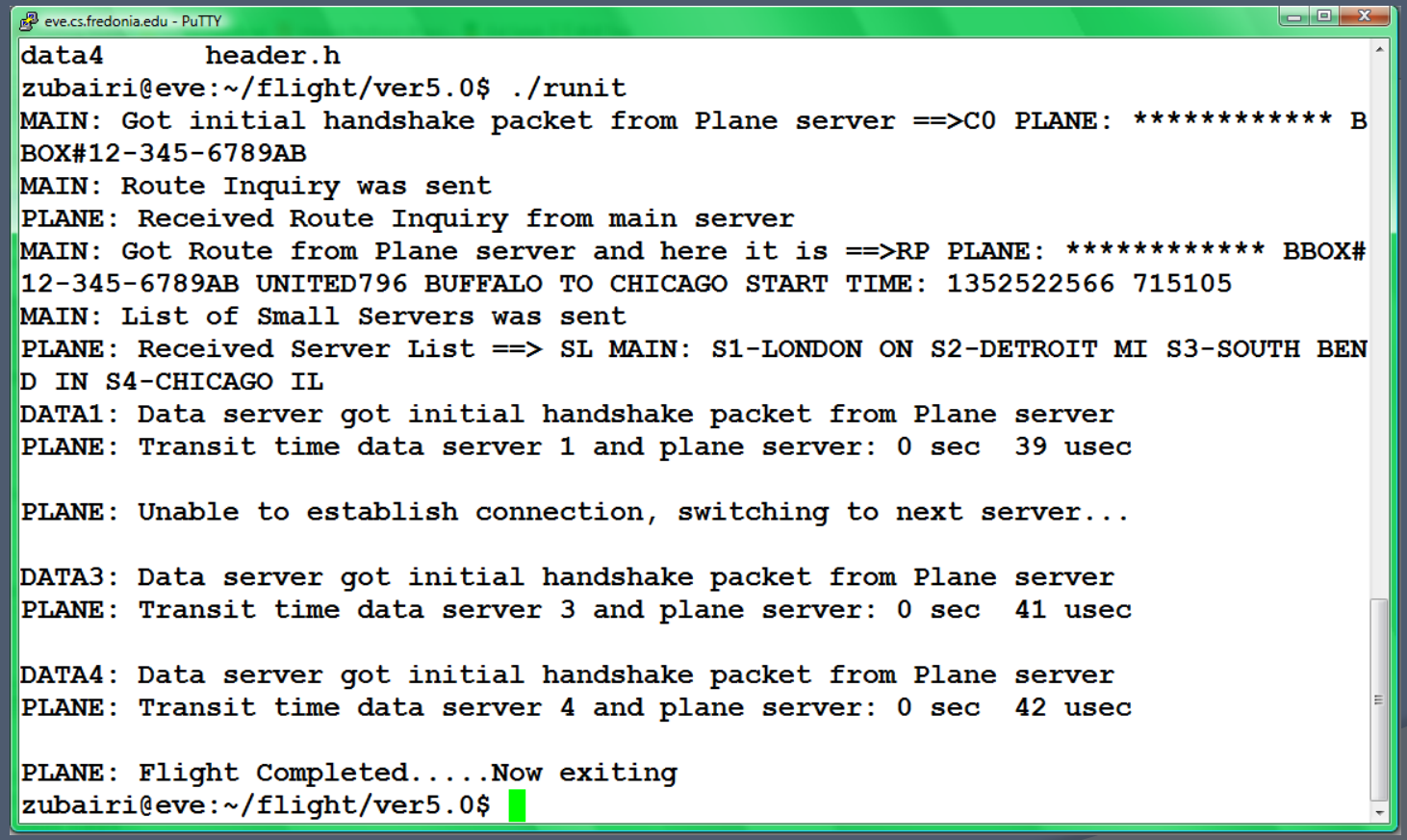
Demo


eve.cs.fredonia.edu - PuTTY
data4 header.h
zubairi@eve:~/flight/ver5.0$ ./runit
MAIN: Got initial handshake packet from Plane server ==>C0 PLANE: ********** B
BOX#12-345-6789AB
MAIN: Route Inquiry was sent
PLANE: Received Route Inquiry from main server
MAIN: Got Route from Plane server and here it is ==>RP PLANE: ********** BBOX#
12-345-6789AB UNITED796 BUFFALO TO CHICAGO START TIME: 1352522566 715105
MAIN: List of Small Servers was sent
PLANE: Received Server List ==> SL MAIN: S1-LONDON ON S2-DETROIT MI S3-SOUTH BEN
D IN S4-CHICAGO IL
DATA1: Data server got initial handshake packet from Plane server
PLANE: Transit time data server 1 and plane server: 0 sec 39 usec
PLANE: Unable to establish connection, switching to next server...
DATA3: Data server got initial handshake packet from Plane server
PLANE: Transit time data server 3 and plane server: 0 sec 41 usec
DATA4: Data server got initial handshake packet from Plane server
PLANE: Transit time data server 4 and plane server: 0 sec 42 usec
PLANE: Flight Completed.....Now exiting
zubairi@eve:~/flight/ver5.0$

Conclusion

- Real-time flight data tracker system is designed to circumvent the need to find the black box after a flight mishap
- The system is distributed, scalable, reliable and realistic given the bandwidths available today
- The aviation sector and interested parties may encourage more work in this direction by contacting the PI.
- Next step is to experiment with FDR interface using ARINC 429 bus and transmitting 12-bit data words after collection and compression

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