RESEARCH ARTICLE OPEN ACCESS

Rebuilding of A702a protocol to facilitate testing of Flight Management Systems

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Abstract:

A702a Protocol describes the management system core and its interaction with the display system. It is extremely restrictive when used with the testing system and does not allow for testing of every possible set of inputs, thus the tool proposed recreates the A702a protocol using python and overrides the management system core to test all possible set of inputs. The tool developed takes in labels as inputs and prompts the properties for each label. The information is decoded as per ARINC 429 and transmitted as per the A702a protocol. The text file generated is fed into the testing system for acceptance. The playback tool generates the required text file which is then fed into the testing system. The testing system then accepts the text file if it is in the correct format.

Keywords — **A702a, ARINC 429**

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I. INTRODUCTION

The software used within the avionics industry need to be extremely safe and reliable. They come under safety critical systems like the healthcare industry. These softwares have to undergo high levels of testing according to the DO-178 standards with acceptance rate of above 95 percent. As the software deployed in the air vehicles have to be kept in working order, they have to be tested very frequently.

A702a protocol is used for transmitting messages between flight management system and other systems inside a cockpit. This protocol defines how the management system should transmit the data. It defines the limit on amount of data that can be transmitted and also lays down the standard with which the transmission should occur so that it can be read and understood by other devices like the display system. A702a classifies the data into background data and dynamic data. Dynamic data is used for information that is periodically refreshed like Active waypoint. Background data is used for aperiodic transmissions like for management system data layer, Selected Approach Id. Working along with this protocol is the A429 label properties standard.

A label consists of a set of words which have to be transmitted together. It is characterised by a number. Each label will have a defining property associated with it. All data is entered as a floating value or a character by the user. A429 describes how the labels are constructed as well as how the data within those labels have to be transformed into a word which will be accepted by the devices in the cockpit

II. LITERATURE REVIEW

The study in [1], mostly focuses on creating a flight management system for next generation by computing real time data to compute and optimize trajectory. It also creates an error modelling system based on 7 state variables namely mass, geodetic latitude, geodetic longitude, altitude, true air speed, flight path angle, heading. An insight into the history and development of flight management system was given in [2]. The study in [3], focused on improvements made in the ARINC standards from 429 to 653 series. Different types of protocols for communication between flight management system and other devices were compared and analyzed in [4] this included a study of virtual

links and AFDX. Study in [5] analyzed the protocols for avionics wireless networks based on security and operational requirements. This comparison was done in a lab environment on a tool called Analysis Program Panorama V.

III. METHODOLOGY

The protocol A702 has two categories of data which are sent from management system to display system. Dynamic and background. The user is given a list of dynamic labels. They can choose any label from the list. The user is then given a list of background labels out of which he can choose. These labels are fetched from the A702 database. According to the properties of the label, user is prompted to enter the values for each of the property. Encapsulating the raw data values as hex words is done as per the A429 label properties database. Character decoding, latitude and longitude decoding, radius decoding are some examples of the decoding done as per the type of packet being sent. Generating the hex values in the required time slice is done as per A702 label sequence. The hex values are copied into a text file which is fed in to the simulator for acceptance.

IV. DESIGN

As seen in Fig 1, the tool prompts the user for the list of dynamic labels to be transmitted. The tool checks whether the labels exist in the dynamic label database. For the existing labels it fetches the properties of each label and prompts the user to feed in the values for the corresponding properties. The next module then converts these properties to hex words as per the ARINC 429 standard. The tool then prompts the user for background labels and checks whether they exist in the background label database. For the existing labels it fetches the properties and prompts the user to feed in the values for each property. These values are converted into hex words. The next module takes the hex words from both the dynamic and background labels and puts it in 8 blocks with each block consisting of 64 words. The remaining words in each block are filled with filler words. These blocks are sent periodically every 50 milliseconds. The blocks are put into a text file along with the transmitting information. The text file is then sent into the simulator. The simulator will produce a report indicating whether the text file is accepted or not.

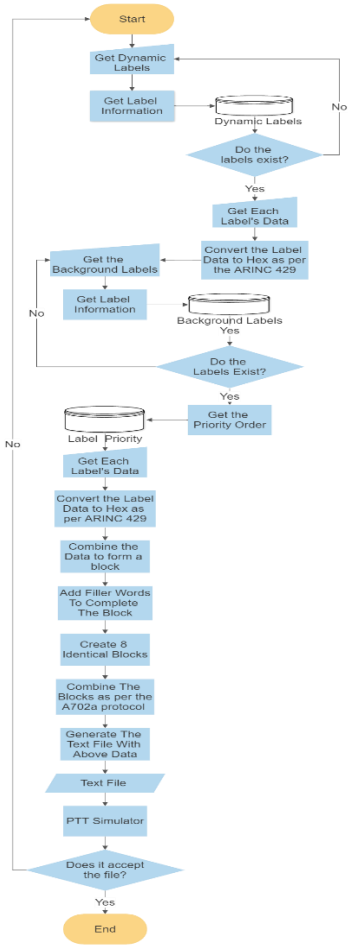

Fig. 1 Flowchart showing the generation of hex words from user input

V. CONCLUSION

This paper brings out steps involved in rebuilding the A702a protocol to increase the robustness of the testing of flight plans.

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