

Retraction

Retracted: Forward Design Method of Avionics System Based on Communication

Mobile Information Systems

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

- (1) Discrepancies in scope
- (2) Discrepancies in the description of the research reported
- (3) Discrepancies between the availability of data and the research described
- (4) Inappropriate citations
- (5) Incoherent, meaningless and/or irrelevant content included in the article
- (6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

References

- [1] Y. Peng, "Forward Design Method of Avionics System Based on Communication," *Mobile Information Systems*, vol. 2021, Article ID 5984066, 6 pages, 2021.

Research Article

Forward Design Method of Avionics System Based on Communication

Yuyang Peng 

Faculty of Air Navigation Electronics and Telecommunications, National Aviation University, Kyiv 03058, Ukraine

Correspondence should be addressed to Yuyang Peng; peter_garcia_00@subr.edu

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With the rapid development of computer technology, electronic technology, and control technology, communication-based avionics systems can provide greater potential for the improvement of aircraft combat capabilities. Moreover, during the flight, passengers have an increasing demand for space communications. How to provide passengers with a communication-based aerospace electronic system that is indistinguishable from the ground during the flight is a problem that needs to be solved urgently. The research on the forward design method of this system has been highly valued by experts at home and abroad. This article is a communication-based forward design method for avionics systems. Based on the development of aerospace data communication technology, this article discusses the advantages of the application of the CCSDS (Consultative Committee for Space Data Systems) protocol in the design of aerospace electronic communication systems. This research designs the technical scheme of the entire aerospace communication electronic system and refers to the relevant CCSDS protocol to complete the design of the distributor's fast transmission telemetry package and the distributor's slow transmission telemetry package. This article introduces the two existing architectures of the integrated avionics system, compares and analyzes them, and then elaborates the integrated avionics system architecture based on trusted computing and the trust chain transfer mechanism. The experimental results show that the method designed in this paper uses the NBSP basic protocol in an aeronautical communication environment with a nesting depth of 2 s. When the data transmission delay is 2 s, the NBSP scheme is 0.9 and the NERON scheme is 0.4. This shows that the design method of this study is able to meet the requirements of the system and technical indicators.

1. Introduction

In recent years, with the development of aerospace technology, the data processed by spacecraft are trending towards diversity, complexity, and standard internationalization [1, 2]. In order to adapt to the development trend of space data communication technology, selecting a suitable forward design method for the aerospace electronic communication system has become a top priority [3, 4]. Therefore, the research on the forward design method of the system puts forward an urgent need [5, 6]. In response to the above problems, simplifying the mapping process in the design process of communication-based avionics systems, dynamically reconfiguring system resources according to the operating environment, realizing effective invocation and redundant support of various resources, and improving

the utilization of system resources have become urgent problems [7, 8].

Many scholars at home and abroad have conducted in-depth discussions on the design method of the avionics department based on communication. For example, Gong and Yang designed and analyzed the feasibility test of the airborne avionics system [7]. Kong integrated multimodule research on the avionics simulation system design method [8]. Qiu et al. used cloud computing technology to design the spacecraft avionics system [9]. It can be seen that the research on the forward design of the avionics system in this article is of great significance.

In this paper, the forward design method of the avionics system based on communication is researched. This article first designs the overall package architecture of the remote control package and the telemetry package and the design of

the specific leading head. According to the main functions that the distributor communication system needs to achieve, the distributor's fast transmission telemetry package and distributor's slow transmission are designed for the distributor. The telemetry package defines the relevant content of the data field bytes of all packages. At the same time, a nested NEMO (network mobility) routing optimization scheme based on router and unsolicited neighbor advertisement is proposed to eliminate network "nestedness" logically. Finally, simulation proves that this research can effectively reduce the data transmission delay in the forward design of communication-based parallel electronic systems. The research in this paper can not only provide a template and reference for the design of the aerospace electronic system based on communication but also lay a solid technical foundation for the future application of aerospace communication and CCSDS protocol and international cooperation.

2. Forward Design Method of Avionics System Based on Communication

2.1. Communication-Based Avionics System Architecture. The system architecture is based on reliable computing theories and methods; it integrates reliable TPM chips and reliable hardware into integrated avionics system hardware and adds a secure core to the microkernel, logically creating a reliable operating environment for the system and adding reliability. Many measures have been taken, such as the use of monitors to enhance the reliability of aviation systems [10]. Reliable hardware support provides a root of trust for the avionics system, which is the foundation of trust for the entire system, and ordinary users cannot change it. The confidence transfer model described later can be used to transfer the confidence upwards. The design scheme proposed in this study is to optimize the nested mobility network routing of the avionics communication electronic system. The scheme is collectively referred to as RONAC.

2.2. Forward Design of Avionics System Based on Communication

2.2.1. Source Package Design. In the communication transmission process, the source packet, as the carrier of data, is the most important part of the entire communication system. According to the direction of transmission, the source package can be divided into remote control package and telemetry package. The biggest feature of the remote control package and telemetry package designed based on the CCSDS protocol is that the data field only specifies the maximum length of the field without other restrictions, which greatly improves the flexibility of the data length and transmission rate.

The source packet is mainly composed of two parts: the packet leading header and the packet data field. The packet's leading header contains relevant information such as packet identification and counting. The application process identifier is used to identify which application process the source

package belongs to. The information about the packet length and the position in the same group in the packet leader header must be the first to be known by the receiving end during the receiving process [11]. A source package has only one application process identifier. The packet data field mainly stores the information that needs to be transmitted based on the function, such as current, voltage, and switch state. The packet leading header and the packet data field are closely connected.

In the process of generating a source packet, the following three aspects are mainly considered, namely, the probability of a certain packet length, the different packet lengths generated in the same application process, and the time dependence of source packet generation (in some periodic processes, these packets will be generated regularly in time, such as the fast transmission telemetry packet of the distributor in this design). Usually this type of packet is a segmented function in time, so the data generation of this type of source packet can be represented by a segmented function.

2.2.2. Specific Design of Function Source Package Data

(1) Distributor Bus Command Packet. The functions to be completed by the distributor bus command packet are as follows: according to actual needs, the bus command identification and command data content are sent to the power distribution manager [12]. Therefore, in the byte allocation position, Byte1~Byte10 are allocated as packet header information, including packet identification, packet sequence control, packet length, service type and service subtype, and source identifier information.

2.2.3. Distributor Slow Transmission Telemetry Package. The task of the slow transmission telemetry packet of the distributor is to identify the time when the source packet is generated and to monitor the output current of 8 L-shaped switches and 12 C-shaped switch output currents. Therefore, in the byte allocation position, Byte1~Byte8 are allocated as packet header information, including packet identification, packet sequence control, packet length, and service type and service subtype information.

3. Experimental Research on the Forward Design Method of Avionics System Based on Communication

3.1. Experiment-Related Process

3.1.1. Self-Positioning of Mobile Routers in the Mobility Internal Environment of Aeronautical Communication Networks. The nMR (nest MR) connects to nMR6, and nMR6 immediately sends router advertisement information with flag bit R-flag to nMR through its internal interface. After receiving the router advertisement message, nMR6 distinguishes whether the router it is connected to is MR according to the R-flag. If the R-flag bit is set, it indicates that the router connected to it acts as an MR. In this case, the

router advertisement information carries a mobile network gateway (MNG) option with a size of 20 bytes.

3.1.2. Mobile Router Local Routing Table Update. The nMR is updated, and its accurate position inside the nested network is obtained; it sends an autonomous neighbor routing notification message to its directly connected parent MR through its external interface.

3.1.3. Route Optimization. When the MNN (Mobile Network Node) inside the nested network sends data to the ground correspondent node, the data packet first reaches the directly connected parent nMR node. In order to complete the data forwarding, the nMR will perform the following operations: the source address of the data packet is replaced with its own care-of address, the care-of address of the MNN is put into the home address destination option, and the destination address correspondent node remains unchanged. Then, the nMR forwards the data to the rMR (root router) through the two-way tunnel between the nMR and

the rMR, and the rMR forwards the data to the AR and then the correspondent node.

3.2. Avionics System Performance Indicators. The software configuration items, subsystems, and total systems in the avionics system have certain requirements for the environment and resources, such as CPU and network.

Among them, the performance index $PI = (r_Name, \{(p, b)\})$. r_Name represents the identification of the resource; $(p, b) \in P \times B$, $P = \{p_1, p_2, p_3, \dots, p_n\}$ ($n > 0$) represents the collection of resource attribute names, $B = \{b_1, b_2, b_3, \dots, b_n\}$ ($n > 0$) represents the collection of resource attribute values, and $b_i = [lower, upper]$, where lower represents the lower bound and upper represents the upper bound.

For example, the hardware requirements of a subsystem in an avionics system are that the main frequency of the microprocessor is not less than 1000 MHz, the memory is not less than 1024 MB, the storage capacity is not less than 1024 MB, and the read/write speed is greater than 5.6 MB/s, which can be expressed as follows:

$$\left\{ (CPU, \{(MHz, [1000, \infty])\}), (Memory, \{All, [1024 MB, \infty])\}), (Disk, \left\{ (capacity, [1024 MB, \infty]), (iospeed, \left[\frac{5.6 MB}{s}, \infty \right]) \right\} \right\}. \quad (1)$$

4. Experimental Analysis of Forward Design Method of Avionics System Based on Communication

4.1. Comparison of Transmission Delay. The transmission delay simulation of aeronautical communication nested NEMO network is mainly divided into the simulation comparison of NEMO external transmission delay and NEMO internal transmission delay.

For the external transmission delay of aeronautical communication nested NEMO network, because the NBSP scheme does not optimize the data transmission path, all data packets need to be encapsulated and forwarded by the MR home agent and nMR inside the nested network. Therefore, the basic protocol of NBSP is used in the aeronautical communication environment with a depth of nesting. The comparison of external data transmission delay is shown in Table 1.

It can be clearly seen from Figure 1 that when the nesting level of nesting NEMO is 0, the data transmission delay of NBSP is higher than that of NERON and RONAC schemes. This is because the data transmission of the NBSP scheme needs to go through home agent forwarding. With the increase in the number of nested network layers, the data transmission delay of the NBSP scheme increases sharply, the transmission delay of the NERON scheme increases slowly, and the transmission delay of the RONAC scheme remains unchanged. This is because the RONAC solution can not only optimize the AR and Path between rMRs but

also optimize the routes inside nested NEMOs and establish bidirectional tunnels between rMRs and all nMRs. This is equivalent to changing all nMRs with nesting level > 1 to a nonnested topology network structure with nesting level number = 0.

Optimizing the RONAC scheme within the nested NEMO network to reduce the transmission delay, that is, reduces the data transmission delay by sacrificing certain signaling consumption. In order to prove the efficiency of the RONAC scheme in the aeronautical communication nested NEMO network, its relative signaling consumption increases and relative transmission delay reduction parameters are simulated, as shown in Table 2.

As shown in Figure 2, when the nesting depth of the nested NEMO network is less than 4, the percentage increase in signaling consumption is greater than the percentage decrease in the external or internal data transmission delay. This is because when the number of nesting levels is small, there are fewer intermediate nMRs for data transmission, but the signaling consumption is not reduced in order to optimize the internal nested network. The RONAC scheme sacrifices a certain amount of signaling to reduce the data transmission delay, but compared with the performance improvement in transmission delay brought by the introduced signaling consumption, the modified scheme is significantly better than the NERON scheme. This is because it is used in this scheme. The increased speed of the optimized signaling consumption is less than the decreased speed of the data transmission delay.

TABLE 1: NEMO external data transmission delay comparison chart.

| Date transfer delay | NBSP | NERON | RONAC |
|---------------------|------|-------|-------|
| 0 | 0.4 | 0.3 | 0.3 |
| 2 | 0.9 | 0.4 | 0.35 |
| 4 | 1.8 | 0.5 | 0.3 |
| 6 | 2.7 | 0.6 | 0.3 |
| 8 | 3.6 | 0.7 | 0.3 |
| 10 | 4.5 | 0.8 | 0.3 |
| 12 | 5.4 | 1 | 0.3 |

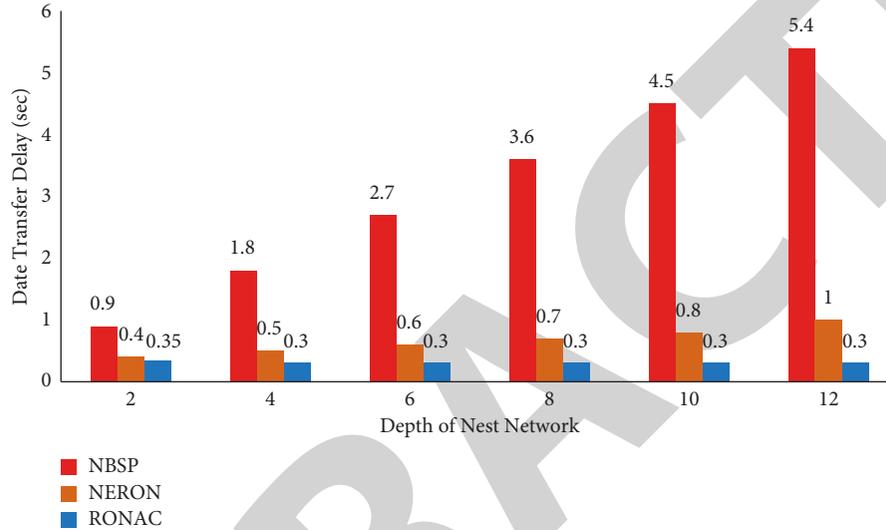


FIGURE 1: NEMO external data transmission delay comparison chart.

TABLE 2: Relative comparison chart of signaling consumption and transmission delay.

| Depth of NEMO | Signal percentage increase | Percentage of external transmission delay reduction | Percentage of internal transmission delay reduction |
|---------------|----------------------------|---|---|
| 1 | 1.1 | 0.05 | 0 |
| 2 | 0.8 | 0.2 | 0 |
| 4 | 0.4 | 0.38 | 0.38 |
| 6 | 0.3 | 0.51 | 0.53 |
| 8 | 0.15 | 0.61 | 0.62 |
| 10 | 0.1 | 0.62 | 0.65 |

4.2. *Comparison of the Relationship between Signaling Consumption and the Number of NMRs in NMO.* Assuming that the nesting depth of the parent nested MR involved in the current MR is 5, that is, $\delta = 5$, the signaling consumption of the NERON scheme and the RONAC scheme with the number of internal nMRs in the nested network is studied, as shown in Table 3.

It can be seen from Figure 3 that because the RONAC scheme optimizes the path between rMR and the desired nMR inside the NEMO network, its signaling consumption increases as the number of nMRs inside the nested network increases, while in NERON, the signaling consumption of the scheme remains unchanged.

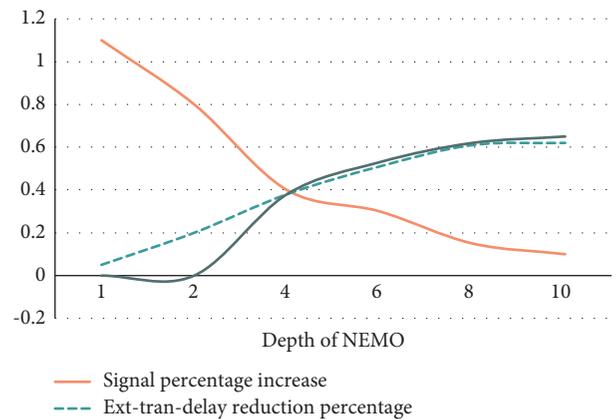


FIGURE 2: Relative comparison chart of signaling consumption and transmission delay.

4.3. *Comparison of MNN Data Transmission Delay within NEMO.* For the RONAC scheme, for communication between MNNs in the same nested network with a nesting level greater than 1, the transmission delay has nothing to do with the nesting level. Therefore, the data communication transmission delay is compared between the NERON scheme and the RONAC scheme in the MNN inside the nested network, and the comparison result is shown in Figure 4.

TABLE 3: Comparison of the relationship between signaling consumption and the number of nMRs in NEMO.

| Depth of NEMO | RONAC | NERON |
|---------------|-------|-------|
| 0 | 396 | 387 |
| 10 | 492 | 387 |
| 20 | 588 | 387 |
| 30 | 680 | 387 |
| 40 | 772 | 387 |

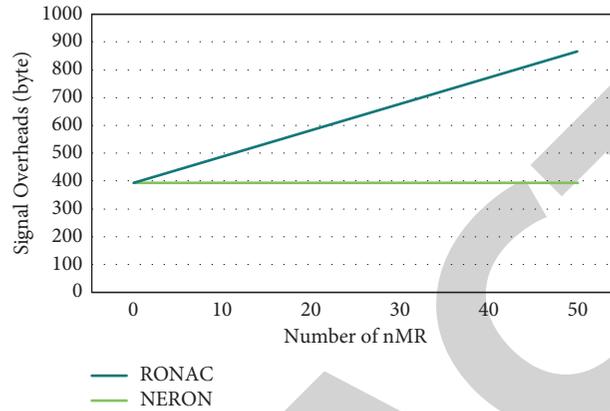


FIGURE 3: Comparison of the relationship between signaling consumption and the number of nMRs in NEMO.

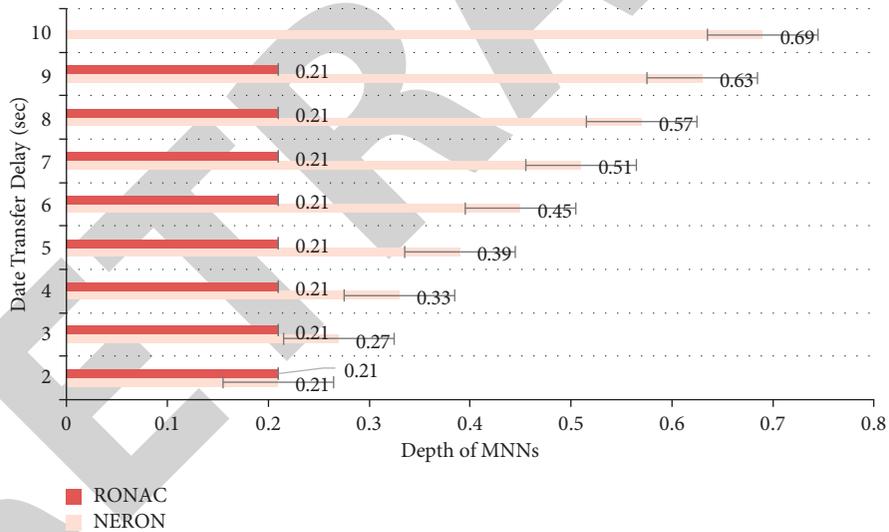


FIGURE 4: Comparison of MNN data transmission delay within NEMO.

It can be seen from Figure 4 that the internal data transmission delay of the RONAC scheme will not increase with the increase in the number of nesting layers. On the contrary, the data transmission delay of the NERON scheme is proportional to the number of nesting layers of the NEMO network. This is because when the NERON solution transmits data internally, the data will be forwarded and processed by the intermediate nMR, while the RONAC solution avoids the forwarding and processing of the intermediate nMR by establishing a two-way tunnel, which will reduce the data transmission delay, but it will introduce certain signaling consumption.

5. Conclusions

This research is based on the forward research and distribution of communication-based avionics systems. First, according to the functional requirements and application scenarios of the avionics system, considering the need for high self-organization and high throughput capabilities of the network, the overall package architecture and package architecture of remote control packages and telemetry packages are designed. The specific design of the leading head, according to the main functions that the distributor communication system needs to achieve, has designed the

distributor fast transmission telemetry packet and the distributor slow transmission telemetry packet and defines the byte position of the data field of all packets. Finally, simulation proves that this study can effectively reduce the data transmission delay, in the forward design of communication-based parallel electronic systems. It improves the use efficiency of communication system technology.

Second, in response to the above research, we use software to simulate and design the aviation data link at the routing layer, network layer, and link layer to simulate the data link communication system. According to the standards proposed by avionics Architecture Committee, a complete avionics architecture and several independent security architectures are established in this paper. Based on the comparative analysis of the two system architectures, a comprehensive avionics architecture based on trusted computing is proposed. The research in this paper can not only provide a template and reference for the design of aerospace power distribution device communication system but also lay a solid technical foundation for the future application and international cooperation of the space power distribution device data communication and CCSDS protocol.

Data Availability

The data underlying the results presented in the study are included within the manuscript.

Conflicts of Interest

The author declares that there are no conflicts of interest.

Authors' Contributions

The author has seen the manuscript and approved to submit to your journal

Acknowledgments

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