

# Study on Network Error Analysis and Locating based on Integrated Information Decision System

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**Abstract.** Integrated information decision system (IIDS) integrates multiple sub-system developed by many facilities, including almost hundred kinds of software, which provides with various services, such as email, short messages, drawing and sharing. Because the under-layer protocols are different, user standards are not unified, many errors are occurred during the stages of setup, configuration, and operation, which seriously affect the usage. Because the errors are various, which may be happened in different operation phases, stages, TCP/IP communication protocol layers, sub-system software, it is necessary to design a network error analysis and locating tool for IIDS to solve the above problems. This paper studies on network error analysis and locating based on IIDS, which provides strong theory and technology supports for the running and communicating of IIDS.

## 1. Introduction

Modern high techniques rely on high efficient and real time information services working in order, which can stably run on mobile terminal end. Integrated information decision system (IIDS) integrates multiple sub-system developed by many facilities, including almost hundred kinds of software, which provides with various services, such as email, short messages, drawing and sharing. This requires IIDS to be running stably and efficiently. However, IIDS has the following problems:

First, because of the complexity of actual tasks and complexity of information communication, IIDS always has the problem of information communication blocked or communication error, and leads to that tasks cannot be assigned or information cannot be shared. The current system lacks of effective error locating of system information errors which affect the operation of major tasks.

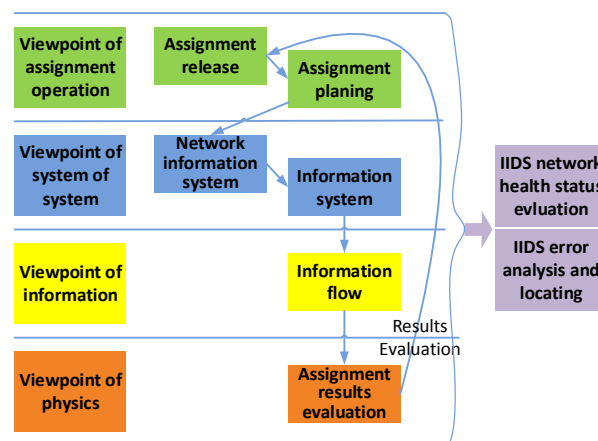
Second, the design of task planning requires for restrict timing and has uncertainty. Major task planning also requires the support of IIDS. Thus, operators have to make full use of IIDS, and in the meantime, to quickly diagnosis and solve the errors of IIDS.

Current work to solve the problem of error diagnosis and locating has considered many kinds of errors that may happened in the network. For example, if a cable gets problems, computers that connected to the cable cannot connect to the network. Some other errors may be caused by server, or some processes are not working, which may lead to information lost. In order to locate the error, and improve the quality of experience for users, [1] proposed an error locating model based on K-neighbor machine learning method, which can solve the errors caused by network bandwidth is too narrow and signal strength is too low. [2] mainly considered the exception of network message, and proposed an error analysis methods, which can be used to multi-network message analysis systems. Current work only focused on network errors that under specific situations, but cannot be applied to the communication problems in IIDS.

In order to solve the above problems, we analyze the system requirement to find out in which way we can analyze and locate the network error information. Figure 1 shows system requirement analysis. From the viewpoints of assignment operation, the information flow is transmitted from assignment



release to assignment planning. From the viewpoints of system of system, we can analyze network health status of network information system and information system. From the viewpoint of information, information transmission status is unclear. And from the viewpoint of physics, IIDS also lacks of feedbacks of evaluation results. As the path of information transmission is not clear, it is hard to evaluate assignment results. According to the above discussion, this paper proposed a network information analysis and locating tool based on PHM technique, which uses distributed error analysis and locating tool to collect information transmitted in the IIDS network, to determine network health status, to obtain information of the errors, and to find out where is the error, in order to solve the communication problems of IIDS.



**Figure 1.** System requirement analysis.

## 2. Related work of error analysis and locating

PHM (Prognostics and Health Management) is a whole new resolution for management of health state, which integrates the latest research results of modern information technology, and artificial intelligent [3]. PHM monitors the exchanging service operation state of external information for the whole IIDS, and prejudices and diagnoses the probably errors, by monitoring the data in data transmission network in real-time.

Currently, the PHM technology in abroad countries has extended from program design to project verification, which has been applied to huge complicate system, including aerospace, Industrial manufacturing, water conservancy, and nuclear power, etc. [4]. In our country, many trades is developing studies on PHM technologies and related theories, which has made Industry standards and development specifications of PHM[5].

In our country, PHM has been mainly applied to the domain of aerospace, which is mainly used to monitor the performance state of airplane and their motors. In the meantime, some work also took research on the theory of PHM, the construction of PHM system architecture, and the verification of the effect of PHM technology on maintenance mode [6].

Reference [7] has made comparison analysis on various program of Airborne PHM system architecture, and proposed a 4-layer architecture structure which contains unit layer PHM, sub-system layer PHM, domain layer PHM, and platform layer PHM. Reference [8] builds up topology of system equipment according to the error characteristics of UVA system, and constructs the logical system structure of UVA PHM system. Reference [9] proposed an architecture of integrated modular aerospace electronic system and PHM, which is suitable for the online upgrade and maintenance of aerospace electronic system.

Currently, the maintenance of devices mainly contains periodic inspection and after-maintenance, which costs huge human and material resources, and the efficiency is very low. PHM has the following functions of error detection and isolation, error diagnosis, error prediction, health management, and component lift tracking.

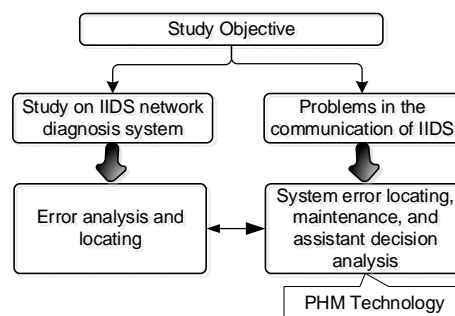
PHM system has been applied to different domains including aerospace and industry, which has the same basic theory, and the difference is that the technologies and methods in specific applications in different domains are different. The development of PHM has been gone through 3 stages including error diagnosis, error predication, and system integration. Currently, the study on PHM aims to improve the error diagnosis and prediction accuracy, and extend the application domains. PHM has been successfully applied to military and civil aviation, which has broad prospects in various domains.

### 3. Network Error Analysis and Locating Program Design

#### 3.1 Study Objects

This paper has developed technique study on network error analysis and locating for IIDS. The proposed technique adopts distributed architecture, which is setup to each node in the network, to obtain data transmitted in the network, analyze the obtained data, and also find out the position of errors. Actually, to design such a network error analysis and locating tool is required to solve the following problems: First, to effectively recognize and locating the errors of system information status. Second, to carry out effective assistant decision and technique maintenance for existing errors.

And the general study framework of network error analysis and locating method of IIDS is shown as figure 2. The main research objective is to solve the above problem and construct an error analysis and locating system to achieve the transparency of assignment operation in each unit, and accuracy of technique maintenance.



**Figure 2.** General study framework.

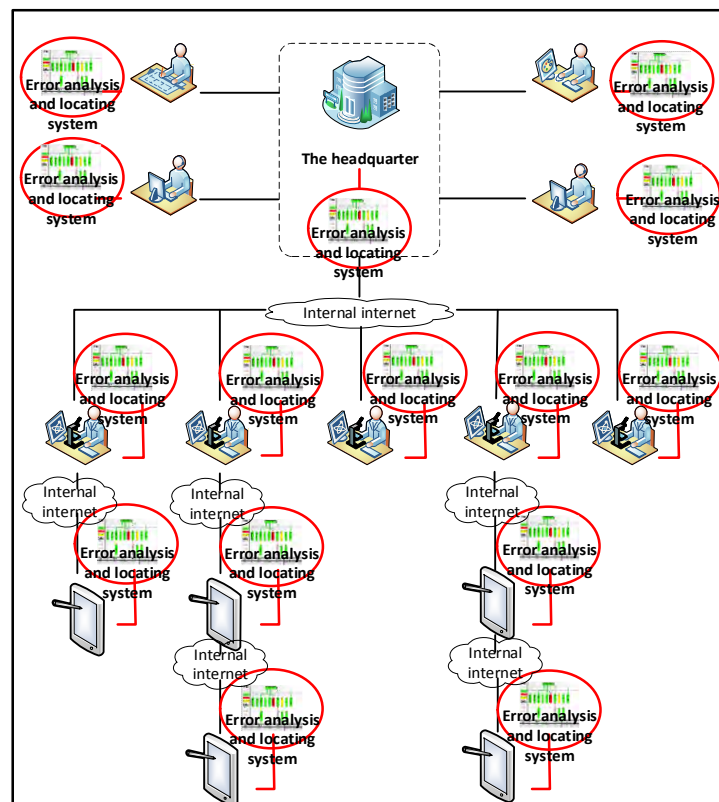
In order to improve the ability of assignment planning, decision, and operation based on information system, and provide strong theory and technology supports for the running and communicating of IIDS, we have applied PHM technology to analyze data and locate errors follow the following steps [10].

- (1) Data collection. This is using different sensors to detect and collect related parameters of the detected system, which makes valid information transfer and information transmission using collected data.
- (2) Information Induction Processing. This part of outputs includes sensor data that is after filter, compress and simplify, and also includes spectral data and other characteristic data.
- (3) State detection. Its function is mainly to compare this data with predetermined failure criterion, in order to monitor current state, and also to provide error alert ability according to those predetermined threshold of various parameters.
- (4) Health evaluation. It mainly evaluates the health state of detected system (or subsystem, component), if they have the phenomenon of parameter degradation, and generates error diagnosis records and makes sure the possibility of errors.
- (5) Error prediction and decision. This part can use the above mentioned data to evaluate and predict the future health state of the monitored system, and gives decision, suggestion and solution.
- (6) Maintenance and decision. It mainly includes human-machine interface and machine-machine interface.

### 3.2 System Design

Error analysis and locating system is to analyze the errors of IIDS and its device operation status, and makes sure the reason and location of errors, as well as the supporting services of the errors, in order to make the system continuously and stably running, and solve the problems in time. The main contents of error analysis and locating includes, to analysis the reliability of network node links, to analysis information transmission and flow, to analysis the effect of operation environment and external environment on system operation, and to determine error information and error location.

According to the characteristics of IIDS information dynamically changing in real time, and the data transmission network open in full time, it has to control the system network in fulltime. First, real time performance analysis and dynamic display, to measure in real time, analyze, and evaluate the standard of network and device, and form a series reports of device exception report, data capacity analysis, and network performance characteristics, etc. By comparing with different types of data, to analysis the operation status of network and devices, configuration, analysis and integration of the task information, external information exchanging information of IIDS, and information flow states. Second, the real-time error prejudgment and diagnosis based on PHM, has the function of error automatically answer, locating the position of errors in time, and precisely determination of the error nature and degree, which can find out the reasons of errors quickly, and provide with assistant decision for error maintenance.



**Figure 3.** System general deployment structure based on IIDS

**3.2.1 System General Structure.** In order to make full use of the functions of IIDS, and solve the problems, such as communication, information sharing, information security, and information monitoring, etc. in the IIDS, this paper proposes to construct an online monitoring tool to monitor the operation states and system failures of IIDS. The main function is precise error locating, error maintenance, and assistant decision. The external exchanging information operation status and data transmission status of the devices in the error analysis and locating system. When a supporting service in the IIDS has problems, data links have errors or information flow blocked the system, the error

analysis and locating system can alarm in time, and quickly and precisely locating the errors, and provides with assistant decision function for error maintenance.

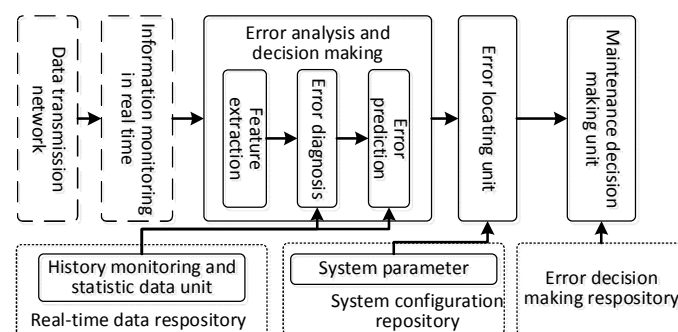
This paper studies on an error analysis and locating system based on IIDS, which deployment is based on IIDS. When the IP resources of the whole IIDS are limited and other factors that make the system hardware cannot be used, the deployment that is based on IIDS can be adopted, which is setting up the error analysis and locating system software to each computer and sharing the hardware platform with IIDS. The advantage is not taking IP resources, but it requires to have high coupling degree with IIDS. The general deployment is shown as figure 3.

The proposed system carries out error prejudgment and diagnosis in real-time for IIDS based on PHM, which has the functions of automatically answering, locating the positions of errors in time, and precisely obtaining the nature and extend of the errors.

**3.2.2 System Software Design.** The proposed system adopts PHM to prejudge and diagnosis the IIDS. PHM has the functions of error testing and diagnosis, performance testing, error prejudgment, health management. The proposed analysis and locating system, which has been deployed to all nodes in the IIDS, can complete tasks like performance testing, error diagnosis of IIDS, and achieve the error predicting of key system and components.

The work flow of error analysis and locating system is shown as figure 4, which includes data monitoring in real time, feature extraction, state monitoring, error diagnosis, error predicting, error locating, and maintenance decision, etc.

Network error analysis and locating system has been embedded into IIDS, which can get all system operation states of IIDS by the information monitoring system. The proposed error analysis and locating system can extract features of monitored information by error analysis and decision making function, and get the operation state information of key parts and key links, and also can make diagnosis and prediction when compared with history monitoring data and find the location of errors. The proposed system can also summary and analyze the error diagnosis results and location information. Given the error problems and solutions in the error decision making repository, the proposed system can provide maintenance and decision making information.



**Figure 4.** Error analysis and locating system.

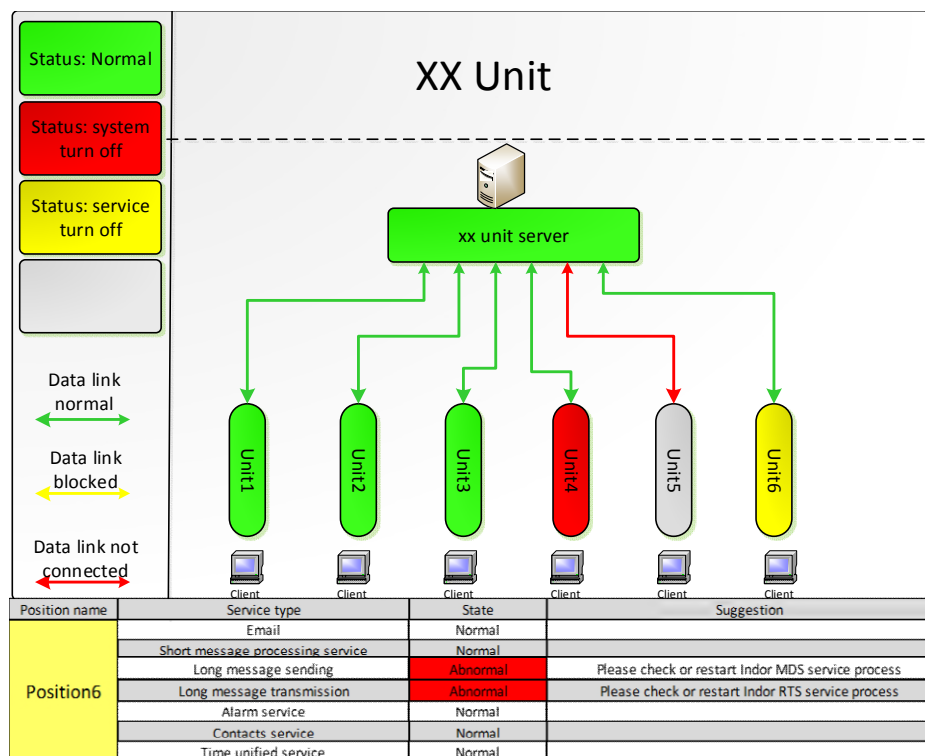
The network error analysis and locating system can get all data including the operation states of starting services in each server and client, and data links communication states in real time for IIDS. The proposed system can diagnosis, locate and alarm for the software service error and data link communication error for IIDS. In the meantime, the error information can report to higher unit in real time, until sending to the server of headquarter. The proposed system can make operator understand the error states of IIDS and data transmission network, and change the working plan in time, so that they can adapt to the various assignment demanding.

#### 4. System Prototype Implementation

In order to guarantee the adaptability and reliability of online monitoring system in practice, this paper also implements a prototype of this system, which analyzes and locates IIDS system errors. System prototype can display the analysis and locating results for monitored information, and provide with the

results of error diagnosis. For each devices in the network, this prototype can display exchanging service operation states of external information, and data transmission states among devices, which is shown as figure 5.

The device states of each position in IIDS use different color to present the states of clients and servers, according to the monitored states of starting services of clients and servers in IIDS. The green box represents that the device or server works normally. The red box represents that the system is running, but the IIDS software is turned off. The yellow box represents that some important services in the server or devices have gone wrong. The gray box represents that the data links gone wrong, and cannot get the operation state of this device. Clicking any box can show all external information exchanging states of the server or clients in a table.



**Figure 5.** The states of each position in xx Unit.

## 5. Conclusion

The proposed network error analysis and diagnosis tool can determine and locate the errors of IIDS in 3 minutes, and can give alarm and change the position states for the whole system at the same time. The proposed tool can provide solutions of many major problems happened in the joint tests and interconnections of IIDS, including the position of errors which is hard to precisely and effectively located, and providing error assistant decision and technique maintenance in real time, which is also very hard to carry out in practice.

## 6. References

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