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Redundant Power Supply for Networking Devices

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Abstract:

The computation is gradually shifting toward network dominated domain. The blackout caused by power loss impacts the networking sector very adversely. This makes a reliable power supply a necessity. This paper introduces the concept of highly reliable power supply system which is capable of keeping the networking node uptime at 100%. Smart cards getting power supply from different energy sources are proposed. The cards are designed to work in master-slave configuration. Architectures are classified for different energy source system. Cards are made to work in redundancy to improve the reliability. A highly reliable architecture for the same is proposed.

Keywords — Power Supply Card, Node Element, Redundant Power Supply, Uninterrupted Power, Networking.

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I. INTRODUCTION

In the networking domain, the amount of data flow is very huge. All the domains are gradually shifting towards network-oriented approaches. For example, banking sector, automobile sector, data centers, nuclear power plants etc. are all using networking elements to send or receive data. Power supply is the necessity of such networking elements and power loss even for a microsecond might cause tremendous amount of loss. To avoid such loss, we need to ensure uninterrupted power supply to the node elements.

In order to fulfill this requirement, we propose to make intelligent systems which will take input power from different energy sources and will feed this power to the node element. Such intelligent system can be termed as cards. These cards are basically the interface between the node and the power supply, but the only difference being that these cards are intelligent. The node element will be having different slots for each of the card. We will insert each card in different slot and feed up the power to each of them from different energy source. The diagram in fig.1 tries to explain the structure of the node element and the cards along with the power supply connections. The above fig represents how the proposed system would look like. Bothe the cards being inserted in the chassis will be feeding on power coming from different energy sources. The cards will be designed to work in master-slave configuration. One card is running as master and the other one as slave. If there is a power disruption in the first card, there is a switch to the other card and the second card becomes master. Once the first card's problem has been resolved and it is up, it starts acting as slave. This master slave configuration is implemented by using software.

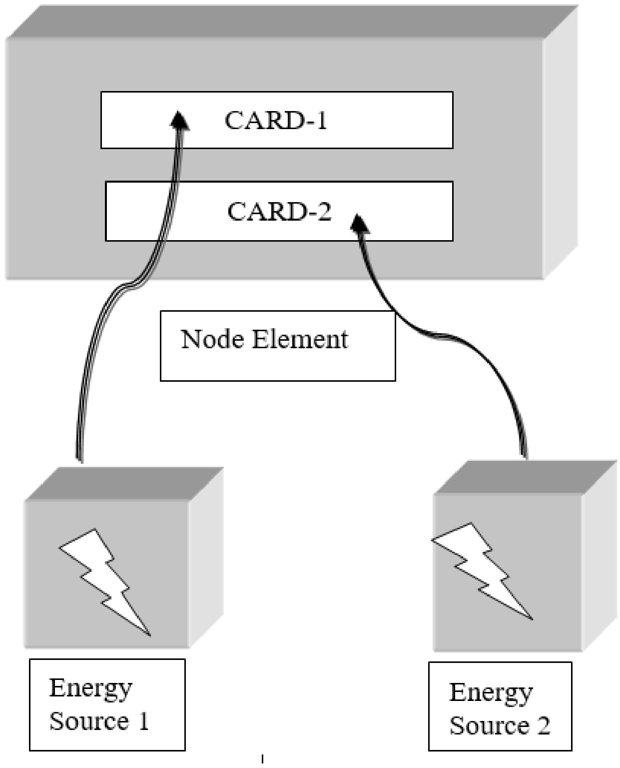

Fig.1 Node Element with Two Power supply Cards

II. METHODOLOGY

The proposed system is made such that all functionalities related to node element happen via some card. Apart from power supply card, the node will contain other cards as well.

All these cards will integrate together and will cause the node element to perform its desired operation that is data flow.

All the cards to be put in node element are listed below: -

1. Data Card
2. Management Card
3. Fan Tray Card
4. Power Supply Cards

Fig.2 shows pictorial representation of the node element with all the cards intact.

Data Card will be connected to traffic feed. The data packets to be sent and received flow to and from the node element via this data card. These data cards can be of varying data carrying capacity based on the needs of the node element.

Power Supply Cards are used to facilitate the working of data cards so that we get the uninterrupted flow of data traffic across data card. Management Card is the one which is used to manage the functioning of the entire node element. If any of the card is having any issues, such events are reported to the management card. Management card further reports such events to the user via an interactive UI. Power Supply Cards are the ones used to fulfill power requirements of the node element. There are two power supply cards used to meet the redundancy purpose. Fan tray card will consist of fans which will help to reduce heat from the node element. There will always be more than one fans operating at a pre-defined revolutions per minute(rpm). If because of some reason, any of the fan fails then the other fans must alter their speeds to meet the minimum rpm required by the node element for continuous dissipation of heat produced in the node element. This helps in smooth functioning of the node element without any failure.

The flow goes as it is shown in the figure. The working of each of the entity is as below:

1)Connection Establishment: - The node carrying the card is remotely located. In order to access the node and make the UI up and functioning we need to establish connection with the node. This connection is established through ssh or telnet by giving the Ip of the node. After compilation of the codes related, the object file and library-object files generated are fed as input before establishing telnet connection.

2)User Authentication: - After successful connection, the login page is loaded wherein the user has to give login details. These credentials are verified by the main daemon by checking the database. Once the details are verified the node becomes up.

3)UI Bring-Up: - After successful authentication, UI is loaded wherein user can access and perform various actions on node which include warm reboot, cold reboot, Input Voltage monitoring etc. The user can view the node element and the cards present in it.

4)Events and Logs: - Events and logs are maintained so as to facilitate the debugging process. There are various logs which are maintained for this purpose and based on the event or alarm being generated we can go to a particular log and check the series of events that caused that particular event to occur.

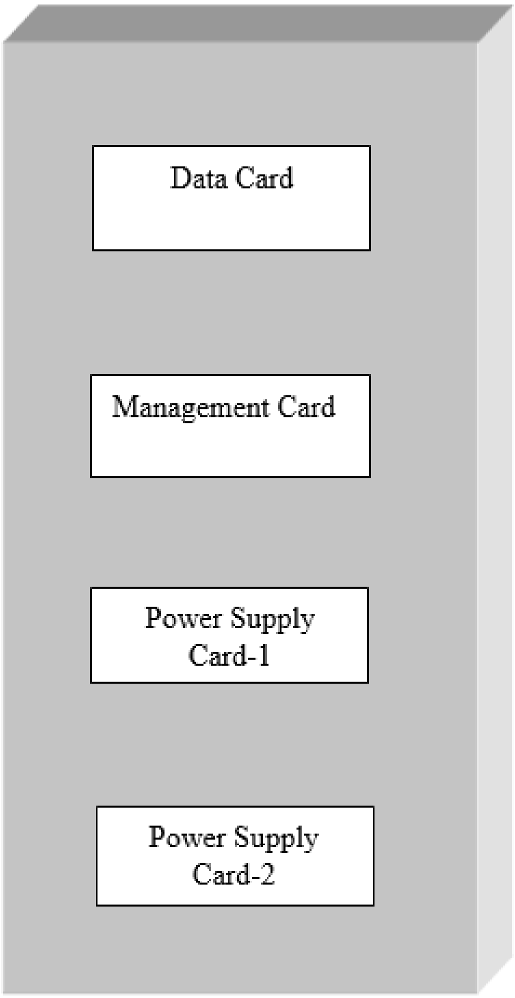

Fig.2 Node Element with all the Cards Intact

A. SOFTWARE IMPLEMENTATION

In order to support the functionalities of the card, there must be well defined software support. Coding needs to be done to build the User Interface for users to interact with the node element. Apart from that, the various functionalities supported by the card must be fulfilled. We will be making a process which is running at the node level at all the times. This process will be running in background hence it can be considered to be daemon. We name this daemon as "main". All the cards will report to this daemon. "main" daemon will be having knowledge about functioning of each of the elements of the node. The configuration or the job to be done by a card is assigned from this "main" daemon. After successful completion of the job, the device reports the status to "main". Similarly, if there is any error happening in device, it is reported to "main" daemon. Such events might be no voltage, redundancy switch, low input voltage high input voltage etc. The architecture of the flow between the "main" daemon and device is shown in fig.3

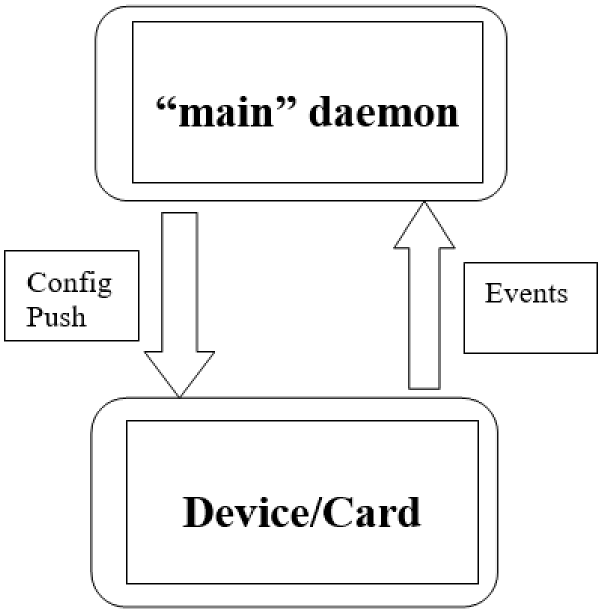

Fig.3 Flow between "main" and Device

B. INTERFACE

The interface between the hardware elements like different cards and the software element i.e. “main” daemon must be well defined. The mechanism of interfacing must be so in such a manner that data stored in the registers of the cards must be read by software and then reported to “main”. For identification of the card a very specific code will be stored in the Read Only Memory of the card. Other information like registers reading the voltage value, registers requesting redundancy switch etc. must be well defined. This interface must be capable of delivering the correct information from device to daemon and from daemon to device under all circumstances. The card structure of a Power Supply Card is shown in fig.4. Fig.4 shows how the registers and ROM are placed in the card. The information about all the cards and their specific codes is already stored in database. Hence, as soon as the card reads the code stored in the ROM of a card is read, it is compared with existing information. This is how the “main” daemon identifies the type and other characteristics of the card. After successful identification, it pushes the necessary configuration in the card so that it can start its functioning. After this the registers are flooded with relevant data received from the “main” daemon. Also, the registers deliver the information from the device to the “main” daemon.

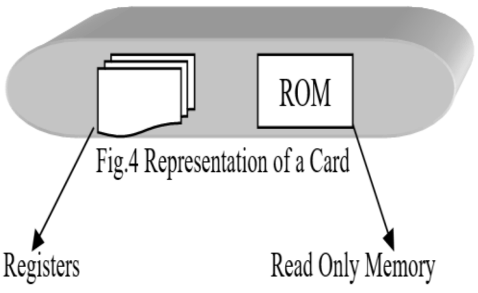

Fig.4 Structure of a Power Supply Card

III. CONCLUSION

The smart card concept introduced lead to 100% uptime of the node element. With two power supply cards working in master-slave configuration, the node element was observed to be up at all times. The functioning of these power supply cards are diagnosed with the help of management card. The traffic flowing through the data card was observed to be uninterrupted while the cards were having a switch. There was no packet drop when the power supply to one of the power supply cards was disconnected. The switch between the two cards was very fast and it did not cause any loss in packets. The card initially working in slave mode came up as master when the power supply to the pre-existing master card was disrupted.

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