Plug and Play for SpaceWire networks: centralized algorithm

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Network configuration and administration

Plug and Play

Human - operator
Plug and Play algorithms (1/2)

- The centralized algorithm

![Centralized Algorithm Diagram]

- The decentralized algorithm

![Decentralized Algorithm Diagram]
**Plug and Play algorithms (2/2)**

<table>
<thead>
<tr>
<th></th>
<th>Offered by NASA</th>
<th>Offered by Dundee University</th>
<th>The algorithm considered in this presentation</th>
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</thead>
<tbody>
<tr>
<td>The initiator</td>
<td>Router</td>
<td>Network Manager</td>
<td>Network Manager</td>
</tr>
<tr>
<td>Type</td>
<td>Centralized and decentralized</td>
<td>Centralized and decentralized</td>
<td>Centralized</td>
</tr>
<tr>
<td>Protocol</td>
<td>New protocol based on RMAP</td>
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<td>RMAP</td>
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<tr>
<td>Requirements</td>
<td>Additional requirements to device software</td>
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<td>Nodes have to process RMAP packets</td>
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SpaceWire and RMAP

- SpaceWire is the standard for high-speed connections and networks for use onboard a spacecraft.

- Remote Memory Access Protocol (RMAP) is used for access to remote program available elements of device.
Defining the network and the devices

The network consists of nodes and routers (devices).

Routers
- Device type
- Routing table
- Notification register
- Active ports

Nodes
- Logic address

![Diagram of network with nodes and routers]
SpaceWire Plug and Play organization

- The initiator is Network Manager. All other devices are targets.
- Network Manager use RMAP, namely:
  - read,
  - response to read,
  - write with acknowledge commands.
The Network Manager Algorithm
Modeling and results (1/2)

**DCNSim** – the simulation software functioning of the distributed network

It was necessary to write the main functions software of the router, node and Network Manager:

- Form,
- Analyze RMAP packets

The SpaceWire standard has already realized in used software
### Modeling and results (2/2)

<table>
<thead>
<tr>
<th></th>
<th>Simple</th>
<th>Tree</th>
<th>Lattice</th>
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</thead>
<tbody>
<tr>
<td>EBR = 0</td>
<td>11730 ns</td>
<td>130160 ns</td>
<td>99230 ns</td>
</tr>
<tr>
<td>EBR = $10^{-12}$</td>
<td>29207340 ns</td>
<td>More than $3 \times 10^8$ ns</td>
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</tr>
</tbody>
</table>
Conclusion

- With standard error bit rate \((10^{-12})\) the algorithm need to have a much more time for configure network.

- With standard error bit rate \((10^{-12})\) the network also will be configured but for a long time.

- In future the decentralized algorithm will be created
Thank you for attention