High Availability in EtherNet/IP Systems using Parallel Redundancy Protocol (PRP)

Technical Track

www.odva.org
Introduction

- High Availability
- PRP Solution And Applications
- Installation
- Initialization
- Operation
- Failure Recovery
High Availability

Availability = MTTF / (MTTF+MTTR)
Mean-Time-To-Fail (MTTF)
Mean-Time-To-Repair (MTTR)

<table>
<thead>
<tr>
<th>Availability, %</th>
<th>Downtime per Year</th>
<th>Downtime per Month</th>
<th>Downtime per Week</th>
</tr>
</thead>
<tbody>
<tr>
<td>99.9999% (“six nines”)</td>
<td>31.5 seconds</td>
<td>2.59 seconds</td>
<td>0.605 seconds</td>
</tr>
<tr>
<td>99.999% (“five nines”)</td>
<td>5.26 minutes</td>
<td>25.9 seconds</td>
<td>6.05 seconds</td>
</tr>
<tr>
<td>99.99% (“four nines”)</td>
<td>52.56 minutes</td>
<td>4.32 minutes</td>
<td>1.01 minutes</td>
</tr>
<tr>
<td>99.95%</td>
<td>4.38 hours</td>
<td>21.56 minutes</td>
<td>5.04 minutes</td>
</tr>
<tr>
<td>99.9% (“three nines”)</td>
<td>8.76 hours</td>
<td>43.2 minutes</td>
<td>10.1 minutes</td>
</tr>
<tr>
<td>99.8%</td>
<td>17.52 hours</td>
<td>86.23 minutes</td>
<td>20.16 minutes</td>
</tr>
<tr>
<td>99.5%</td>
<td>1.83 days</td>
<td>3.60 hours</td>
<td>50.4 minutes</td>
</tr>
<tr>
<td>99% (“two nines”)</td>
<td>3.65 days</td>
<td>7.20 hours</td>
<td>1.68 hours</td>
</tr>
<tr>
<td>90% (“one nines”)</td>
<td>36.5 days</td>
<td>72 hours</td>
<td>16.8 hours</td>
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High Availability

Availability = MTTF / (MTTF+MTTR)

Mean-Time-To-Fail (MTTF)
Mean-Time-To-Repair (MTTR)

High Availability

Impossible to create networks that never fail

Key to High Availability is reduced recovery time

Availability is increased by introducing Redundancy

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Network Redundancy

Dynamic

Static
Network Redundancy

Dynamic

Static
Network Redundancy

Dynamic

Input

Dev

Actv

SW

Stby

SW

Dev

Output
PRP Solution

Static Network Redundancy Solution:

- Defined in IEC 62439-3 Ed 2.0-2012-07, Clause 4
- 100% Network Availability
- 0mS Recovery Time
- Redundant Independent Networks (LAN A/B)
- Redundant copies of Ethernet frame
Plant Network

- Plant
- Process
- Field

Redundant Control Network
Redundant IO Network
Tunnels

Control Room or Another Tunnel

Tunnel Network

LAN A

Router

Safety Niche/Room

Fire Suppression Room

LAN B

Lighting Niche
American Bureau of Shipping requires network redundancy
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Installation

Static Redundancy
Network Symmetry and Resiliency
Rapid Spanning Tree Protocol (RSTP)

Forward Frames > 1522 bytes
Installation

Double Attached Nodes with PRP
Installation

Single Attached Nodes
EtherNet/IP - Install VDANS

Virtual Double Attached Nodes
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Initialization
Initialization
Filtered from VDANS
Introduction

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- Initialization
- Operation
- Failure Recovery
DANP to VDAN

LAN A

LAN B

SW

DANP

A1

A2

A3

A4

B1

B2

B3

B4

Red Box

VDANs

SAN

SAN

SAN

DANP

DANP

DANP

Red Box

VDANs

SAN

SAN

SAN
VDAN to DANP
Red-Box as Proxy
ACD - Direct SANs

Diagram showing network connections and IP addresses labeled as X and Y.
ACD - VDANs
ACD - VDANs
Introduction

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Cable Failure
Cable Failure-SAN Transmit

With Nodes Table Option
Network Device Failure
Device Failure-Before Healing
Device Failure-After Healing
Network Failure
Network Failure-LAN B Only
Red-Box Failure
Questions?

Technical Track

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