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Network Availability

The definition of availability is the probability that a device will perform a required function without failure under defined conditions for a defined period of time. Before a system's availability can be determined, a device's availability must be understood. It is important to keep in mind that every device will have a probability of failure.

There are two main factors that are involved in the calculation of availability: Mean Time Between Failure (MTBF) and Mean Time To Repair (MTTR). MTBF is obtained from the data sheets of the equipment. MTTR is the average time to fix and restore the device in order to be put back into service.

MTTR is a different story as there may be many events and circumstances that influence how long it takes to repair a device once it has failed. MTTR is based on the degree to which the system will be monitored by operators. With N-Tron's N-View OPC monitoring application, an issue with an N-Tron switch can be reported / detected within seconds. A failed switch can be swapped with an on-site spare for minimal down time.

Due to the many variables associated with the value of MTTR, the following assumptions will be made for switch availability calculations. It has been determined that the N-Tron switch has failed. All availabilities are calculated assuming that there is a person physically at site with a spare switch in hand. N-Tron switch's are not designed to be "repaired" in the field. The switch needs to be physically replaced with a spare for "repair". The person will have a PC and the technical skills to configure an IP address on the fully managed switches. For most systems using N-Tron equipment, the only configuration that is required is to configure an IP address and N-Ring parameters (Ring manager only) for fully managed switches. Other variables for the MTTR can be added on a per system basis.

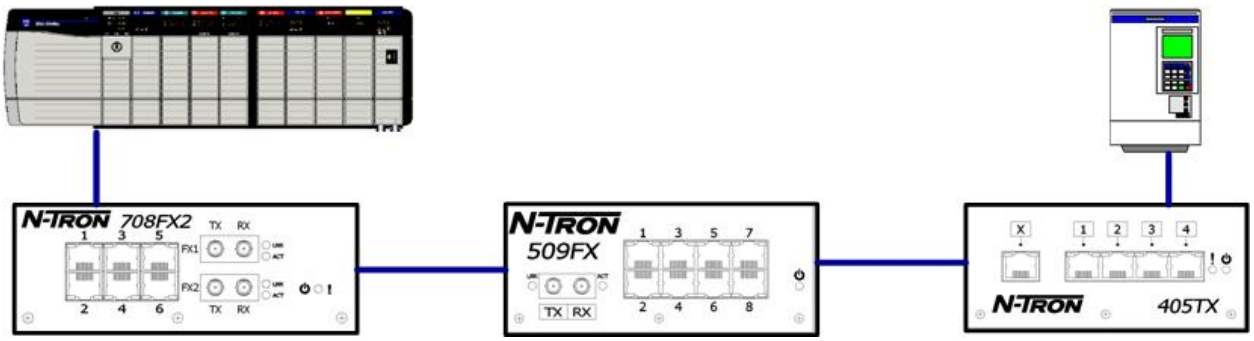
Once MTBF and MTTR are known, the availability of the component can be calculated using the following formula:

$$A = \frac{MTBF}{MTBF + MTTR}$$

Switch Availability = MTBF/(MTBF+MTTR)				
Series Switch	MTBF (hours)	MTTR(hours)	Availability / Switch	Downtime sec /yr
100	2000000	0.0167	99.999999165%	0.26
300	2000000	0.0167	99.999999165%	0.26
400	2000000	0.0167	99.999999165%	0.26
500	2000000	0.0167	99.999999165%	0.26
700	2000000	0.05	99.9999975%	0.79
900	2000000	0.0167	99.999999165%	0.26
1000	2000000	0.0167	99.999999165%	0.26
7000	1000000	0.05	99.999995%	1.58
9000	1000000	0.05	99.999995%	1.58

Calculating Network Availability

Thus far the discussion has focused on the availability of a single device but networks involve many devices all of which must be functioning in order to maintain the operation of the intended application. Let's take a simple network to demonstrate how to calculate a Network's Availability.



In the above network there are three switches: 700, 500, & 400 all in series. There is a PLC connected at one end and a drive connected to the other end. In order for the PLC to communicate with the drive, data must pass through all three switches. Therefore each of the switches availability must be included in the network's availability.

This is an example of a dependent, serial system in which the end-to-end availability is a function of the availability of each item in the series.

Network Availability = Switch 1 availability x Switch 2 availability x Switch 3 availability

$A_N = SW_1 \times SW_2 \times SW_3$

$= 0.99999975 \times 0.99999999165 \times 0.99999999165$

= 99.999996% Availability

All devices in the system need to be functioning in order for the PLC to communicate with the drive; however, this calculation process also highlights several other, maybe less obvious, facts. First, no matter how high the availability of individual devices, when two or more are required to function in a series, the resulting end-to-end availability will be lowered. The resulting downtime (1 – availability) of the series is actually the sum of the unavailability factors of the individual devices. By adding more devices in the series, one is adding to the unavailability of the end-to-end system. This is a great point to remember as we really like to add things to networks – routers, firewalls, remote I/O, etc… The message in this is that if a very high availability is required, the number of devices in the series should be kept low.

The downtime of the example network:

Downtime / year = (1 - .999999975) + (1- 0.99999999165) + (1- 0.99999999165)

Downtime / year = 0.0000000417 x 31536000 (seconds / year)

Downtime / year = 1.315 seconds / year