Media-Level Redundancy Plug-In

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Media-Level Redundancy Plug-In

Help version 1.022

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Overview

The Media-Level Redundancy Plug-In facilitates duplicate or backup systems used to maintain reliable communications with the critical components in the environment. This practice allows the duplicate, or redundant, system to take over without interruption of service in the event of a failure. This server supports two types of redundancy:

- **Communications Path Redundancy:** To communicate with the same device over multiple communications methods. For example, a device may support communications via TCP and RS-485. For redundancy, configure a primary communications path via TCP, but assign the device to use RS-485 when the Ethernet network is unavailable.
- **Device Pair Redundancy:** To communicate with two identical devices configured as a redundant unit (each running the same logic). For example, two devices are on the same RS-485 network monitoring the same process condition. Client monitoring software must be able to receive information from at least one of these devices to maintain the information integrity.

Notes:

1. To eliminate the single point of failure with either the communications path or the device, users can combine the redundancy types.
2. A redundant connection contains a pair of devices that use Communications Path Redundancy or Device Pair Redundancy. Each device is designated primary or secondary. Redundancy configuration begins by identifying the primary device and proceeds by choosing a different, compatible device to use as the secondary device.

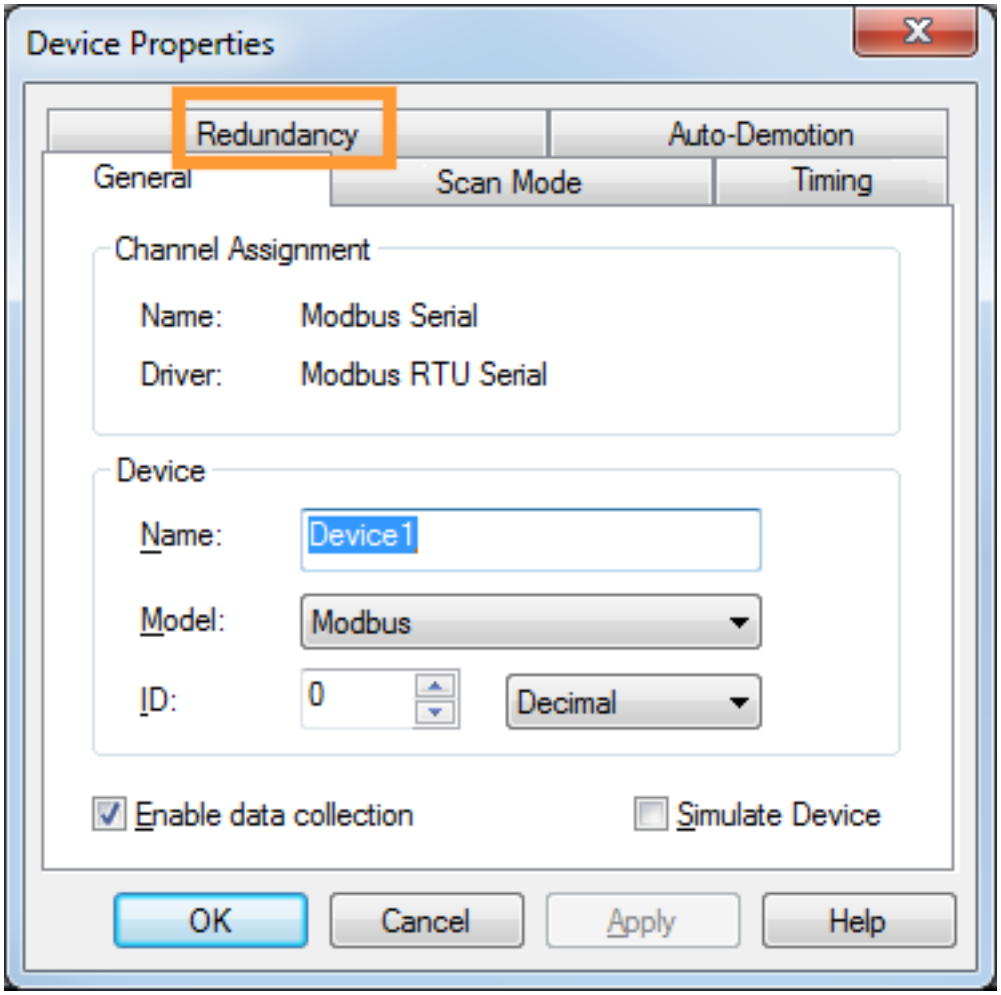
Supported Use

Media Level Redundancy is available on devices that communicate using serial, Ethernet, or Modbus Plus drivers operating in master mode or communicating using the OPC UA Client Driver. Media Level Redundancy cannot be enabled if a suitable device does not exist for the secondary device. Suitability is determined based on the following:

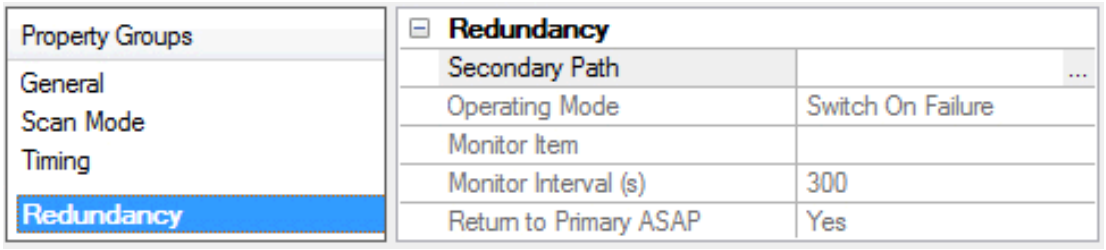
- The device is not the same as the primary.
- The device is not already in use as a primary in another redundant pair (such that a circular path back to the primary on the new redundant pair results).
- The device uses a serial, Ethernet, or Modbus Plus master driver or the OPC UA Client Driver for communications.

Accessing the Media Level Redundancy Plug-In

The Media Level Redundancy Plug-In is only available to supported devices. The user interface is available through the **Redundancy** tab in Device Properties dialog box on the primary device, where supported.



Redundancy Options

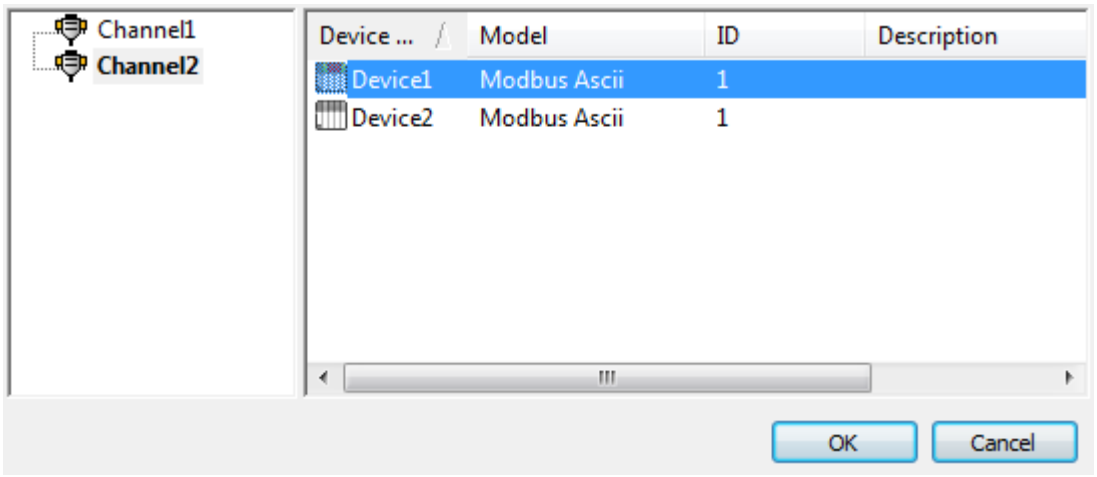


Descriptions of the parameters are as follows:

Secondary device: This string specifies the explicit, unaliased path to the device serving as backup should the primary device fail. The valid format is <*channel*>.<*device*>. The default setting is blank.

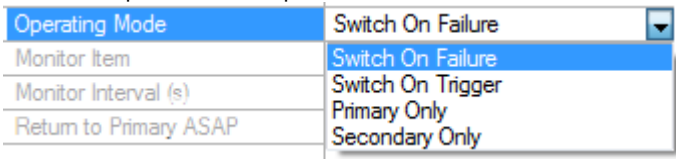
Tip: If the device specified by this path is on the same channel as the primary device, the redundancy type is Device Path Redundancy. Otherwise, it is Communications Path Redundancy.

To browse for a device, click the icon located to the right of the entry field. In Device Browser, locate the device and double-click or click **Apply**.



Tip: A device with a redundant configuration displays the icon in the server Configuration Project View user interface.

Operating mode: This parameter specifies how the active device is chosen at runtime. Options include Switch On Failure, Switch On Trigger, Primary Only, and Secondary Only. The default setting is Switch On Failure. Descriptions of the options are as follows:



- **Switch On Failure**: In this mode, communication fails over to the secondary device when the primary device enters an error state (and vice versa). Initial communication begins on the primary device. The options are described **below**. For detailed information, refer to **Switch On Failure**.
- **Switch On Trigger**: In this mode, the server monitors a configured trigger item. When the configured trigger condition becomes true, communication switches over to the secondary device. As long as the

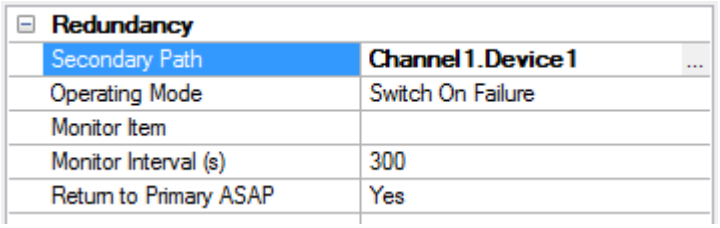
condition is false, communication remains on the primary device. Communication is initiated with the primary device until the trigger condition can be evaluated. The options are described **below**. For detailed information, refer to **Switch On Trigger**.

Note: For Switch On Trigger mode, the communication path is dictated entirely by the trigger state. Unlike the Switch On Failure mode, the communication path is not updated in the case of compromised physical communication.

- **Primary Only**: In this mode, communication is fixed to the primary device regardless of the error state. This option is used for maintenance when the secondary device needs to be taken offline.
- **Secondary Only**: In this mode, communication is fixed to the secondary device regardless of the error state. This option is used for maintenance when the primary device needs to be taken offline.

Click **OK** to implement the changes and close the dialog box.
Click **Cancel** to close the dialog box without implement the changes.
Click **Apply** to implement the changes without closing the dialog box.
Click **Help** to access the documentation.

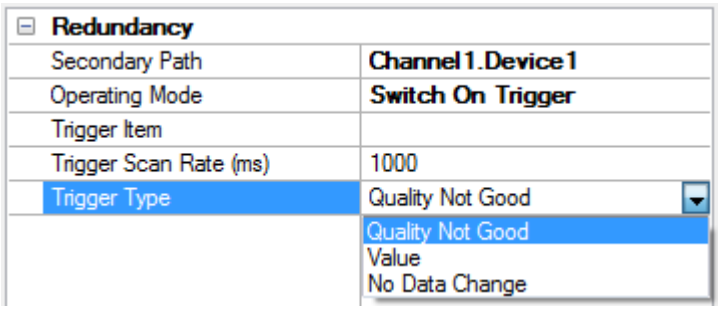
The following settings are only available when **Switch On Failure** operating mode is selected.



- **Monitor item:** This optional parameter specifies a valid device tag name or address on both the primary and secondary devices that is used to monitor communications on both devices. Valid formats include the device address (such as "400001") or a partially qualified tag name (such as "Tag1") to identify a static tag at the device level (or "Group1.Tag1" to identify a tag in "Group1" and so forth). The default setting is blank.

  Note: Only tags that require device communication may be used. *For more information, refer to **Monitor Items**.*
- **Poll monitor item every *x* seconds:** This parameter specifies the rate at which the Monitor Item is polled on each device in a redundant pair. It is the rate at which the error tag updates on the inactive device in a pair. The valid range is 30 to 999 seconds. The default setting is 300 seconds.
- **Return to primary connection ASAP after failover:** This option specifies whether the primary device should become the active device as soon as possible after a failover. When checked, the primary is re-activated as soon as possible following a transition of its error state from True to False.

The following settings are only available when **Switch On Trigger** operating mode is selected.



- **Trigger item**: This parameter specifies a fully qualified dynamic or static item reference. This item is used as the source of the trigger and is regularly evaluated at the configured scan rate to determine if a switchover is required. To choose a static item reference defined in the server, use the Tag Browser by pressing the browse button.
  Note: The Trigger Item can be any server tag, but cannot be an array data type.
- **Scan rate**: This is the frequency at which the Trigger item is evaluated.
- **Trigger type**: This is the type of condition evaluated on the Trigger item. The supported trigger types are Quality Not Good, Value, and No Data Change.
  - **Quality Not Good**: When the trigger type is configured as Quality Not Good, the Trigger item change in quality to bad or uncertain causes communication to switch to the secondary device. When the Trigger item quality returns to good, communication switches back to the primary.
  - **Value**: When the trigger type is configured as Value, the item is compared using an operator from the drop-down list and data in the entry field. The value entered should be compatible with the data type of the selected trigger item. When the trigger item value meets the condition defined by the configured string and operator, the trigger is considered "set" and communication switches from the primary to the secondary. When the trigger item value no longer meets the criteria, communication switches back to the primary. Available operators are equals (=), does not equal (≠), greater than (>), greater than or equal to (≥), less than (<), and less than or equal to (≤).
    Tips: This field accepts an arbitrary length string of alpha-numeric characters. When the trigger item is a string type, comparisons are case insensitive ("Hello, World" and "HELLO, WORLD" are considered a match). When the trigger item is a float type (double or float type), care must be exercised because comparisons do not consider precision loss (1.499999 is not considered equal to 1.5).
  - **No Data Change**: When the trigger type is configured as No Data Change, the Timeout field represents the period (in milliseconds) during which the trigger item value must change. If the trigger item does not change within the configured period, the trigger is considered "set" and the communication switches from the primary to the secondary. To return to the primary, the value of the trigger item must change twice within the configured timeout period.

See Also:
Switch On Failure
Switch On Trigger

Switch On Failure

Failover

When the operating mode is set to Switch On Failure, failover to the secondary device occurs as soon as the primary device enters an error state. When the secondary device is active, failover to the primary occurs when the primary device is no longer in an error state.

The failed read or write that caused the error state to occur on the primary device is submitted to the secondary device after switchover. Any subsequent failed write completion notifications or tag invalidations received from the primary device are submitted to the secondary device to avoid the failures being reported to the client.

If both the secondary device and the primary device are in an error state, the failed read or write that caused the error state results in a bad-quality update being sent to the client for that item. Any subsequent failures that cannot be handled (due to the devices being in an error state) are passed along to the client in the form of bad-quality updates or write completion failures.

Falling Back to the Primary

If the operating mode is set to Switch On Failure and the "Return to primary connection ASAP after failover" setting is enabled, the error state on the primary device is queried for use each time that a tag is updated (or a write completes on the secondary device) to determine if it is ready. If the primary device is not in an error state, the active device is switched back to the primary device.

Switchover

The internal switchover process is as follows:

1. Set all client items on the active device to inactive, making note of which were active at the time of the switch.
2. Activate all items on the secondary device that were active on the primary device.
3. Request reads and writes for any items that have these actions pending as the result of a failover.
4. Record the active device time as "Previous" for _PreviousActiveSec.
5. Reset the active device time to 0 seconds.
6. Increment the switch count.
7. Post an Event Log message indicating a switchover has occurred.
8. Update the System tags.

See Also:
Redundancy Options

Switch On Trigger

This mode evaluates the configured trigger condition at the configured scan rate. When the condition is true, communication switches to the secondary device. When the condition is not true, communication switches to the primary device.

A common use of this mode is driving switchover between redundant remote servers communicating with the server through two client driver devices. In this case, a Quality Not Good trigger is configured using a tag on the primary remote server as the trigger item. When the quality of that item transitions from good to bad (indicating some sort of communications problem between the remote server and its data source), the server triggers a seamless switch to the secondary remote server.

See Also:
Redundancy Options

Monitor Items

The user-defined monitor item identifies a single item to poll while the active device is in use. This periodic item poll ensures that the inactive device's error state is updated so that it can be switched to when needed.

The default setting is 300 seconds; however, when the active device is in an error state, the default setting is accelerated to a fixed rate of 30 seconds.

When there is no monitor item defined, the first available client item that requires device communications is used for polling if the secondary device is active. When the secondary is communicating successfully, the default setting is 300 seconds; however, when the secondary device is in an error state, the default setting is 30 seconds.

Notes:

1. A poll is not issued unless a minimum of one client item that requires device communications exists on the primary device.
2. The default setting is not accelerated in Switch On Trigger Mode.

Important: An explicitly defined monitor item must require device communication: this ensures that the poll updates the error state.

Dynamic Changes to Redundancy Settings

Changes made to the redundancy settings are applied as soon as they are received from the server Configuration. If the secondary device is the active device at the time of the update, the active device time is reset to zero seconds and a switchover is recorded. At that time, any items that fail to map to the new secondary device receive a bad-quality update.

Note: If the operating mode is set to Switch On Failure, the primary device is active when it is not in an error state. When it is in error state, the secondary device is active.

Runtime Functions

For more information on a specific aspect of the Media Level Redundancy Plug-In runtime functions, select a link from the list below.

Initialization
System Tags
Client Item Management

Initialization

When a project that contains redundant device definitions loads or assigns redundancy settings to a primary device for the first time, the Media Level Redundancy Plug-In initializes each redundant pair to do the following:

- Create system tags on the primary device for monitoring redundancy configuration and state.
- Mirror any items to the secondary device that may already exist on the primary device.
- Set the appropriate device (primary or secondary) active, depending on the parameters in the redundancy definition.
- Begin monitoring the primary device for client requests to add/remove items, change an item's active state or data type, or read/write an item.

System Tags

Each redundancy definition has the following read-only system tags created in the _System tag group on the primary device.

Name	Data Type	Description
_ActivePath	VT_BSTR	The fully qualified path of the active device.
_ActiveSec	VT_UI4	The number of seconds that the active device has been active.
_PreviousActiveSec	VT_UI4	The number of seconds that the previously active device has been active.
_Switchovers	VT_UI4	The number of times the active device has changed.
_OperatingMode	VT_BSTR	The pair's current operating mode.*
_SecondaryPath	VT_BSTR	The current value of the Secondary Device parameter.

*Options include Switch On Failure, Switch On Trigger, Primary Only, and Secondary Only.

Switch On Failure Mode

Name	Data Type	Description
_ActiveMonitor Item	VT_BSTR	The fully-qualified path to the last item used to ping the inactive device.
_FavorPrimary	VT_BOOL	The current value of the Return to primary connection ASAP after failover parameter.
_MonitorItem	VT_BSTR	The current value of the Monitor Item parameter.
_MonitorIntervalSec	VT_UI4	The current value of the Poll Monitor Item Every *x* Seconds parameter.

Switch On Trigger Mode

Name	Data Type	Description
_TriggerItem	VT_BSTR	The fully qualified path of the trigger device.
_TriggerScanRate	VT_UI4	The rate, in milliseconds, at which the trigger item is scanned and evaluated.
_TriggerType	VT_BSTR	The trigger type: one of Quality Not Good, Value, or No Data Change.
_TriggerValue	VT_BSTR	The value used to evaluate the trigger. Context is specific to the trigger type.

Updating System Tags

System tags are updated whenever a switchover occurs or the redundancy configuration changes and periodically at 500 millisecond intervals. If the redundancy configuration is removed from the primary device, the system tags that have an active client reference count receive a bad-quality update to indicate that the data is no longer valid.

See Also:
Redundancy Options

Client Item Management

In all operating modes, the primary device is monitored for add/remove item activity. When this activity is detected, it is mirrored on the secondary device. Although it may take twice as long to complete item addition, it greatly reduces the time it takes to perform a switchover (since the necessary tags are already in place on both devices).

As a side effect of this model, the total tag count is different for the same client conditions with and without redundancy. For example, a project has one channel and two devices, where each device has one static tag defined. If a client maps an item to the tag in Device 1, the total tag count is reported as one. If Device 2 is then configured as the secondary device for Device 1, the same condition results in a total count of two because the tag is mirrored on the secondary device. This increased tag count only affects the server tag count. Clients only see the tag count relevant to the primary device.

Note: Having a monitor item defined can affect the tag count.

Adding Client Items

When a client item is added to the primary device, the item mirrored on the secondary device is generated based on the qualified item ID received from the client. If the item ID maps to a static tag in the project name space beneath the primary device, the leading path information is replaced such that the secondary item ID contains the path to the secondary device followed by the remaining path information that identifies the tag. For the mapping to succeed, this tag must exist on the secondary device.

Client items added using dynamic addressing are passed as-is to the secondary device for validation and addition. For the mapping to succeed, the address must be valid on the secondary device. Any item that cannot be mapped to the secondary device results in an error message.

Data Type Conversion

The Media Level Redundancy Plug-In performs data type conversion for any mirrored item that cannot be mapped with the same data type used on the primary device. Data type equivalence between the primary and secondary device is determined based on the client data type returned from the tag to which the item is assigned. For example, a type conversion is required when an item mapped to a tag on the primary device

uses scaling and the mirrored item is mapped to a tag on the secondary device without scaling, and the scaled data type on the primary device differs from the data type on the secondary device. The same is true when mapping to two scaled tags that have different scaled data types or (two un-scaled tags that have different raw data types).

Notes:

1. A failed conversion results in a bad quality update to the client. A conversion may fail when the range of the two types is different, and the result of the conversion exceeds the range of the target type.
2. For mapping to succeed, the primary and secondary item data types must be compatible (if not equivalent). For example, if the data type on the primary is an array type and the data type on the secondary is not, mapping is not established because a conversion cannot be made between array and non-array types. The same is true when mapping to two arrays with different dimensions.

Error Descriptions

The following error/warning messages may be generated. Click on the link for a description of the message.

<text> does not define a tag and is not a valid <driver name> address on <primary path>.
<text> is not a valid <driver name> address on <secondary path>.
<text> is not a valid trigger item data type.
Failed to activate trigger item <text>.
Monitor item must specify a device tag.
Monitor item specifies a tag that does not exist on the secondary device.
Secondary device <device path> cannot be paired with primary <device path> because a circular dependency would result.
Specified secondary device <device path> cannot be used because the driver type is not supported.
Specified secondary device <device path> is the same as the primary.
Specified secondary device <text> does not exist.
Trigger item must be a valid static or dynamic item reference.
Trigger item <text> is no longer valid. This may cause a quality change that results in a switchover.
The data type of item <text> (<type>) is unsupported. No switchover will be triggered by any value of this item until it is changed to a supported type.

See Also:
Event Log Messages

<Text> does not define a tag and is not a valid <driver name> address on <primary path>.

Reason:
The specified text does not map to a static tag under the primary device; the device driver rejected it as an invalid device address.

<Text> is not a valid <driver name> address on <secondary path>.

Reason:
The specified text is a valid device address on the primary device, but not on the secondary device.

<Text> is not a valid trigger item data type.

Reason:
When loading an XML file with the operating mode set to Switch On Trigger, the XML file must define a trigger item of a data type supported as a trigger item *(see **Trigger Item parameter**)*.

See Also:
Redundancy Options
Switch On Trigger

Failed to activate trigger item <text>.

Reason:

The server was unable to activate a subscription with the configured trigger item. Verify that the trigger item is a valid and accessible item or select a different trigger item.

See Also:

Redundancy Options

Switch On Trigger

Monitor item must specify a device tag.

Reason:

A valid tag was specified on the primary device, but it does not map to something at the driver level that requires device communications. Choose a monitor item that proves communication with the device.

Monitor item specifies a tag that does not exist on the secondary device.

Reason:

The specified text identifies a tag under the primary device, but that same tag does not exist on the secondary device.

Secondary device <device path> cannot be paired with primary <device path> because a circular dependency would result.

Reason:

The specified secondary device is not suitable.

Specified secondary device <device path> cannot be used because the driver type is not supported.

Reason:

The specified secondary device exists, but the channel to which it belongs uses a driver that does not meet the requirements of supported use.

Specified secondary device <device path> is the same as the primary.

Reason:

The secondary device matches the primary device. A single device cannot serve as both the primary and secondary to achieve redundancy.

Specified secondary device <text> does not exist.

Reason:

The specified secondary device is not an actual device.

The data type of item <text> (<type>) is unsupported. No switchover will be triggered by any value of this item until it is changed to a supported type.

Reason:

Redundancy is configured in Switch on Trigger mode and the trigger item has been edited to an unsupported data type. The value trigger type does not support arrays.

See Also:
Redundancy Options
Switch On Trigger

Trigger item must be a valid static or dynamic item reference.

Reason:

When loading an XML file with the operating mode set to Switch On Trigger, the XML file must define a trigger item that is a valid static or dynamic item reference in the server.

See Also:
Redundancy Options
Switch On Trigger

Trigger item <text> is no longer valid. This may cause a quality change that results in a switchover.

Reason:

Redundancy is configured in Switch on Trigger mode and the trigger item has been deleted during operation. This may result in a switchover, depending on the trigger type.

See Also:
Redundancy Options
Switch On Trigger

Event Log Messages

The following Event Log messages may be generated. For more information, refer to the table below.

Event	Type	Message
Change in active device.	Informational	Setting <primary|secondary> device configuration active on <primary device path>.
Removal of redundancy.	Informational	Redundancy disabled on <primary device path>.
Initialization/dynamically adding redundancy to a device.	Informational	Redundancy initialized on <primary device path> using <secondary device path> as the secondary device.
Change in secondary device path.	Informational	Secondary device path on <primary device path> changed to <secondary device path>.
Change in settings (other than secondary device path).	Informational	Redundancy configuration updated on <primary device path>.
Secondary item mapping failure.	Error	Attempt to map redundant item <qualified id> to <secondary device path> failed.

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