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GMS Station SOH Monitoring Configuration Guide

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1. INTRODUCTION

1.1 Description

The GMS Station State-of-Health (SOH) monitoring capability provides the system controller the ability to view current SOH values and calculated statistics for stations and channels, view trend plots of SOH values, be notified when station SOH status changes, and acknowledge or quiet notifications while the station issues are being investigated. The SOH monitoring capability includes components to acquire CD 1.1 protocol station data, extract SOH information from the raw data packets, process the raw SOH information for display, store the SOH information, and display the SOH information in an interactive display. All these components use system and processing configuration to provide the system controller mission-relevant information about station health.

This document is a guide to setting the processing configuration for GMS SOH monitoring.

1.2 System Configuration Description

GMS consists of a set of services providing basic system resources, GMS system resources, and GMS processing services. The **gmskub**e program is used to create, manage, and destroy deployments of all types.

On deployment, the **gmskub**e utility loads default station metadata and processing configuration into the system and may load configuration overrides as specified by gmskub

command line options. Use `gmskub` `--help` for options.

Default GMS configuration files are included in the GMS software repository `gms-common`.

1.3 Processing Configuration Description

The processing configuration contains several different types of configuration objects. Each different configuration object is contained in a separate folder within the processing config (i.e., the `config/processing` folder). Each configuration object is made up various configuration options. Different configuration options can be contained in different files or the same files. Generally, the default configuration option(s) are contained in a single `default.json` file and the override configuration options (those without a default constraint) are contained in an `override.json` file. The default processing configuration is included under `gms-common/config/processing`.

Each processing configuration option has a format which includes the following:

name - Each file contains a name (which is listed inside the file). The name should be descriptive of the file; however, the name does not have an impact on the actual processing.

constraints – Each configuration option contains a list of one or more constraints. Most types of configuration objects require or allow a `DEFAULT` constraint. Which other constraints are

allowed depended upon the type of configuration object (details can be found below)? Each constraint contains the following information:

constraintType – Either DEFAULT or the cast type of the value given in the constraint. Currently the only other value for this STRING. When the constraint Type is DEFAULT the constraintType is the only information included in constraint (i.e. there is no criterion, operator, or value).

criterion – This is what is being constrained. What can be used as a criterion depends upon the configuration object type. Possible criterion includes: StationName, ChannelName, MonitorType, StationGroupName, sohValueType, and protocol

operator – The operator is used to specify if the Value is a single value or list of Values, and if the configuration option is for the listed values or for values not listed. The operator is further divided into two options:

type – Either EQ or IN. EQ can be used if the value contains a single value, IN is used if the value contains a list of values

negated – Either true or false. False is used when the parameters will apply to the values list. True is used when the parameters will apply to the values not listed.

value – this is the value or list of values to which the configuration option is being constrained to applying to

parameters – This lists the parameter types and parameter values. The parameter types are specific to the configuration object.

Note that there are four possible combinations of operator between the type and negated. In order to simplify the remainder of this document they will be referred as follows:

Operator (referred)	Operator Type	Operator negated
EQ	EQ	false
IN	IN	false
NOT EQ	EQ	true
NOT IN	IN	true

There are 16 different types of configuration objects included in the processing configuration:

- acei-merge.processor.mergre-tolerance-ms
- connman.station-parameters
- dataframe-receiver.channel-lookup
- dataman.station-parameters
- global.cd11.station-parameters
- soh-control
- soh-control.channel-capability-rollup
- soh-control.channels-by-monitor-type
- soh-control.soh-monitor-thresholds
- soh-control.soh-monitor-timewindows
- soh-control.soh-monitor-types-for-rollup-channel
- soh-control.soh-monitor-types-for-rollup-station
- soh-control.station-capability-rollup
- soh-control.station-group-capability-rollup
- soh-control.station-group-name
- ui-soh-settings

1.4 SOH Processing Description

GMS Station SOH processing is designed to be very configurable, to allow the system maintainer to define the station groups, stations, channels, and SOH monitors (SOH monitors are the individual status items such as latency of a data packet or GPS status of a sensor channel) that are processed and displayed. Two different rollups of SOH status are supported: a basic worst of SOH status rollup and a mission capability rollup. Each of these can be configured separately.

Data acquisition statistics and SOH status values vary by channel and typically fluctuate over the short term, so a pure real-time display of the raw values could be very noisy and cause unneeded attention. To smooth out these variations for display, GMS processing services compute the SOH monitors using configurable time windows and uses configurable thresholds to define when a monitor is good, marginal, or bad. This result in many potential configuration items, but it is expected that default configuration will apply many stations and some other groups of stations can be configured similarly. To support the exceptions, GMS provides the option to configure any item as needed.

Two of the most important configuration parameters are the `backoffDuration` and `calculationInterval`. These define the SOH Calculation Time Window used to select the data packets that are included in a SOH calculation at each SOH Calculation Time, as shown in Figure 1.

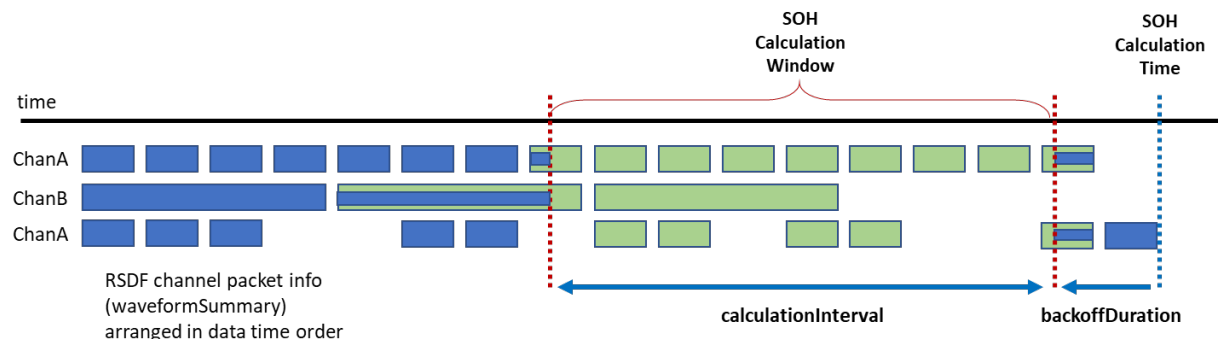


Figure 1. GMS SOH Calculation Time Diagram

The data packets that are used to compute the percent data missing, the data lag, and the percent bad SOH environment values are the green packets that fall within the SOH Calculation Window.

- It is important for the backoffDuration to be tuned based on the nominal data latency for each station, so that data packets that are not expected to be received yet are not included in the SOH Calculation Window, but the backoffDuration isn't so large that the data being displayed are very old.
- It is also important for the calculationInterval to be long enough to smooth out the variation in station status values and also long enough to include some data packets when data latency is higher than normal, so relevant statistics may be displayed about the station, but not so long that relevant changes in the SOH values are not notices.

Another important parameter is the reprocessingPeriod that defines the time delay between SOH calculations. This parameter defines the frequency that the display will be updated with new SOH information. Smaller reprocessing periods mean the SOH calculations are performed more often and will require more processing power. To avoid missing some data packets in the SOH calculations, the reprocessingPeriod should be smaller than the smallest calculationInterval.

For flexibility in display of SOH status for different stations, the thresholds used to determine when a value is good, marginal, or bad are all configurable, but should be kept as common as possible for understandability by the user.

These parameters and others are defined in the Section 3 of this document. Additional guidance and examples are provided in Section 5.

2 GMS SYSTEM CONFIGURATION

2.1.1 GMS System Configuration Properties

GMS includes a system framework based on etcd to distribute system-level parameters such as network hosts and ports, user names, and timeouts.

System parameters are in this file in the GMS code repository:

`gms-common/config/system/gms-system-configuration.properties`

3 GMS PROCESSING CONFIGURATION

3.1 Station Reference

3.1.1 CSS Formatted Station Reference Files

The input for the station reference information are CSS flat files. The required flat files are affiliation.dat, network.dat, instrument.dat, sensor.dat, site.dat and sitechan.dat. The loader expects the affiliation.dat, instrument.dat, sensor.dat, site.dat and sitechan.dat for a specific station to be in a directory named for the station. Additionally, there is a responses directory that contains the FAP formatted response files for the instruments for the station (see Figure 2).

The network.dat file describes the specific networks (station groups) for all the stations. For this reason, the network.dat file is at the same level as the station directories. Note that the N/A value for offdate in the site.dat and sitechan.dat flat files is 2268324, not -1.

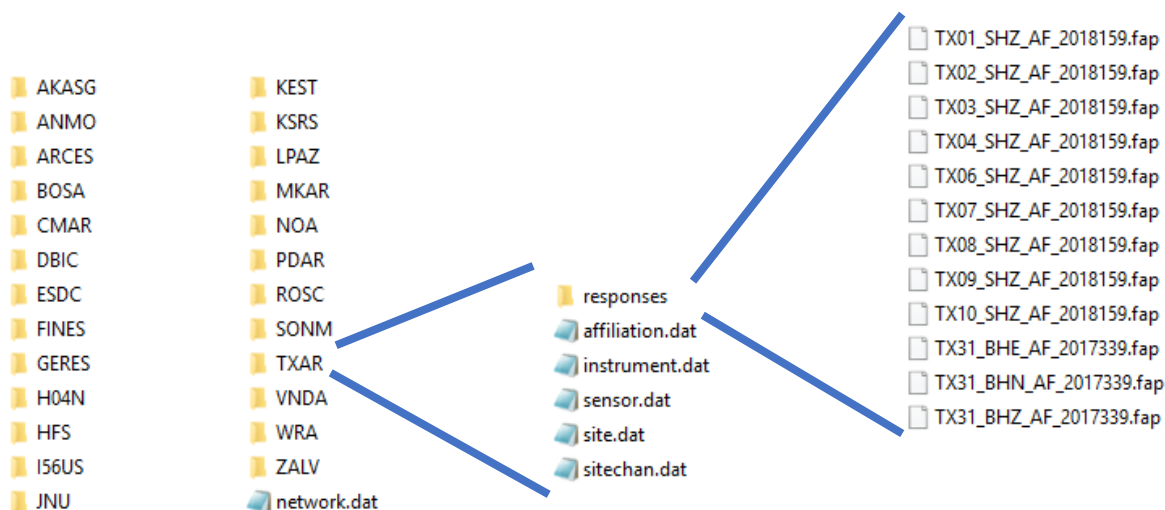


Figure 2. Example of the directory structure for station reference information. Each station level directory contains CSS flat files for affiliation, instrument, sensor, site and sitechan. The responses directory holds the FAP response files for the station.

Station reference files are in this directory in the GMS code repository:

gms-common/config/station-reference/data

3.2 Data Acquisition

3.2.1 Global Parameters

Global parameters used by data acquisition components are in this file in the GMS code repository:

gms-common/config/processing/global.cd11.station-parameters/default.json

stationName	Text string of station to acquire
acquired	Set to true if acquiring the data from the station; set to false if not acquiring the data
frameProcessingDisabled	Set to true if acquiring the data from the station but are not processing the data
portOffset	Offset from a starting port number which is configured in System configuration (cd11-dataconsumer-baseport).

3.2.2 ConnMan Parameters

Parameters used by the da-connman service are in this file in the GMS code repository:

gms-common/config/processing/connman.station-parameters/default.json

\$ref=global.cd11.station-parameters	Pointer to the global station parameters
--------------------------------------	--

3.2.3 DataMan Parameters

Parameters used by the da-dataman service are in these files in the GMS code repository:

gms-common/config/processing/dataman.station-parameters/default.json

\$ref=global.cd11.station-parameters	Pointer to the global station parameters
--------------------------------------	--

gms-common/config/processing/dataframe-receiver.channel-lookup/cd11.json

name	Text string of protocol name
channelIdsByPacketName	Text string comparing the channel information in the raw station data frame to the channel information in the channel-lookup object

3.3 SOH Processing

Time windows, thresholds, rollups, etc.

3.3.1 Processing Time Period

The soh-control configuration object configures the reprocessing period parameter (the time between each round of SOH calculations).

The soh-control configuration object contains a single default.json file which contains a single default constraint and includes a single reprocessingPeriod parameter. The soh-control configuration object is located as follows with the defined constraints:

config/processing/soh-control/default.json

Configuration Option			
Name	description		
default	The one and only configuration option for the soh-control configuration object.		
constraintType	criterion	operator	description
DEFAULT	–	–	defines the constraint as default
parameters	type	description	
reprocessingPeriod	duration	Duration between execution of SOH processing operations	

3.3.2 SOH Display Parameters

The ui.soh-settings configuration object contains parameters used by the UI for SOH. The ui.soh-settings configuration object contains a single default.json file.

The ui.soh-settings configuration object is located as follows with the defined constraints:

config/processing/ui.soh-settings/ui.soh-settings.json

Configuration Option			
Name	description		
default	The one and only configuration option for the ui.soh-settings configuration object.		
constraintType	criterion	operator	description
DEFAULT	–	–	defines the constraint as default
parameters	type	description	
redisplayPeriod	duration	time between display updates in PI11 (not used for PI12)	
acknowledgementQuietDuration	duration	default acknowledgement quiet time	
availableQuietDurations	list of durations	list of selectable durations for quieting a channel monitor	

	sohStationStationStaleDuration	duration	time to wait for SOH objects before setting declaring data outdated (i.e. Last Update Time shows red)
	sohHistoricalDurations	list of durations	list of durations for quick selection on the Trends displays

3.3.3 Station Groups

The soh-control.station-group-names configuration defines which Station Groups are used. Configuration of the capability calculation can be configured per Station Group, Stations are grouped by Station Group in the SOH Overview display, and the both the SOH Overview and Station Statistics display allows the user to filter Stations by Station Group. Stations which are not part of a Station Group listed in the soh-control.station-group-names configuration will not be shown on the UI.

The soh-control.station-group-names configuration does not define the Station Groups by listing the Station which they include. The Stations which are included in the Station Group must be defined in the config/station-reference/stationdata portion of the configuration.

The soh-control.station-group-names configuration contains a single default.json file which list the Station Groups which are displayed on the UI.

The soh-control.station-group-names configuration object is located as follows with the defined constraints:

config/processing/soh-control.station-group-names/default.json

Configuration Option				
	Name	description		
	default	The one and only configuration option for the soh-control.station-group-names configuration object.		
	constraintType	criterion	operator	description
	DEFAULT	–	–	defines the constraint as default
	parameters	type	description	

	stationGroupNames	String list	List of names of station groups used in SOH processing
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3.3.4 SOH Monitor Time Windows

The soh-control.soh-monitor-timewindows configuration contains the backOffDuration and calculationInterval parameters used for the Channel Monitor Value calculations. The soh-control.soh-monitor-timewindows configuration can contain constraints for StationName and MonitorType. While the parameters in the soh-control.soh-monitor-timewindows configuration can vary by MonitorType typically they will only vary by StationName.

config/processing/soh-control.soh-monitor-timewindows/default.json

Configuration Option				
	Name	description		
	default	The overall default for the soh-control.soh-timewindows configuration object. This configuration object is not required if all monitor types are covered by a default_{MonitorType(s)} configuration option for the soh-control.soh-timewindows.		
	constraintType	criterion	operator	description
	DEFAULT	–	–	defines the constraint as default
	parameters	type	description	
	backOfDuration	duration	time offset between calculation time and calculation interval	
	calculationInterval	duration	time length of SOH calculation window	
Configuration Option				
	Name	description		
	default {MonitorType(s)}	Zero or more default configuration options for the soh-control.soh-timewindows configuration object that are specific to a Monitor Type. Each Monitor Type would be covered by a different configuration option or covered by the default. This configuration object is not required there is a default configuration option for soh-control.soh-timewindows. Typically, the soh-control.soh-timewindows configuration options will be the same across Monitor Types and this will not be used.		
	constraintType	criterion	operator	description

DEFAULT	—	—	defines the constraint as default
STRING	MonitorType	ANY	MonitorType(s) to which this configuration option applies (see Appendix A for a list of valid Monitor Types)
parameters	type	description	
backOfDuration	duration	time offset between calculation time and calculation interval	
calculationInterval	duration	time length of SOH calculation window	

config/processing/soh-control.soh-monitor-timewindows/overrides.json

Configuration Option				
	Name	description		
	{Station(s)}	Zero or more override configuration options for the soh-control.soh-timewindows configuration object that are specific to a single station or list of stations.		
	constraintType	criterion	operator	description
	STRING	StationName	ANY	Station Name(s) to which this configuration option applies
	parameters	type	description	
	backOfDuration	duration	time offset between calculation time and calculation interval	
	calculationInterval	duration	time length of SOH calculation window	
Configuration Option				
	Name	description		
	{Station(s) MonitorType(s)}	Zero or more override configuration options for the soh-control.soh-timewindows configuration object that are specific to a Monitor Type. This configuration object is not required there is a default configuration option for soh-control.soh-timewindows. Typically, the soh-		

	control.soh-timewindows configuration options will be the same across Monitor Types and this will not be used.			
	constraintType	criterion	operator	description
	STRING	StationName	ANY	Stations(s) to which this configuration option applies
	STRING	MonitorType	ANY	MonitorType(s) to which this configuration option applies (see Appendix A for a list of valid Monitor Types)
	parameters	type	description	
	backOfDuration	duration	time offset between calculation time and calculation interval	
	calculationInterval	duration	time length of SOH calculation window	

3.3.5 SOH Monitor Thresholds

The soh-control.soh-monitor-thresholds configuration contains the goodThreshold and marginalThreshold parameters used for the Channel Monitor Status calculations. The soh-control.soh-monitor-thresholds configuration can contain constraints for MonitorType, StationName, and ChannelName. The soh-control.soh-monitor-thresholds configuration must include a MonitorType constraint and the Monitor Types included must all have the same SOH Value Type (see Appendix A) with the goodThreshold and marginalThreshold values being a duration (e.g. PT5M) when the SOH Value Type is DURATION and a numeric value (e.g. 5.1) when the SOH Value Type is PERCENT. All Monitor Types listed in Appendix A must be covered by a DEFAULT_{MonitorTypes}.json file.

config/processing/soh-control.soh-monitor-thresholds/default.json

Configuration Option				
	Name	description		
	default {MonitorType(s)}	A default configuration option for each Monitor Type for the soh-control.soh-threshold configuration object that are specific to one or more Monitor Types. Each Monitor Type needs to be covered by a different default configuration option.		
	constraintType	criterion	operator	description

DEFAULT	—	—	defines the constraint as default
STRING	MonitorType	ANY	MonitorType(s) to which this configuration option applies. Monitors covered by the same configuration option must have the same sohValueType (see Appendix A for a list of valid Monitor Types)
parameters	type	description	
goodThreshold	percent (numeric) or duration	Threshold for transition from good to marginal status. For Monitor Types with a sohValueType of DURATION a duration value will be give (e.g. "PT5M"). For Monitor Types with a sohValueType of PERCENT a numeric value will be give (e.g. 5).	
marginalThreshold	percent (numeric) or duration	Threshold for transition from good to marginal status. For Monitor Types with a sohValueType of DURATION a duration value will be give (e.g. "PT5M"). For Monitor Types with a sohValueType of PERCENT a numeric value will be give (e.g. 5).	

config/processing/soh-control.soh-monitor- thresholds/overrides.json

Configuration Option			
Name	description		
{Station MonitorType(s)}	Optional override configuration options for the soh-control.soh-threshold configuration object that are each specific to one or more Monitor Types and one or more Stations.		
constraintType	criterion	operator	description
STRING	MonitorType	ANY	MonitorType(s) to which this configuration option applies. Monitors covered by the same configuration option must have the same sohValueType (see Appendix A for a list of valid Monitor Types)

	STRING	StationName	ANY	Stations(s) to which this configuration option applies
	parameters	type	description	
	goodThreshold	percent (numeric) or duration	Threshold for transition from good to marginal status. For Monitor Types with a sohValueType of DURATION a duration value will be give (e.g. "PT5M"). For Monitor Types with a sohValueType of PERCENT a numeric value will be give (e.g. 5).	
	marginalThreshold	percent (numeric) or duration	Threshold for transition from good to marginal status. For Monitor Types with a sohValueType of DURATION a duration value will be give (e.g. "PT5M"). For Monitor Types with a sohValueType of PERCENT a numeric value will be give (e.g. 5).	

Configuration Option			
Name	description		
{Channel(s) MonitorType(s)}	An override configuration option for the soh-control.soh-threshold configuration object that are specific to one or more Monitor Types and one or more Channels.		
constraintType	criterion	operator	description
STRING	MonitorType	ANY	MonitorType(s) to which this configuration option applies. Monitors covered by the same configuration option must have the same sohValueType (see Appendix A for a list of valid Monitor Types)
STRING	StationName	ANY	Stations(s) to which this configuration option applies
STRING	ChannelName	ANY	Channel Name(s) to which this configuration option applies
parameters	type	description	
goodThreshold	percent (numeric) or duration	Threshold for transition from good to marginal status. For Monitor Types with a sohValueType of DURATION a duration value will be give (e.g. "PT5M"). For Monitor Types with a sohValueType of PERCENT a numeric value will be give (e.g. 5).	
marginalThreshold	percent (numeric) or duration	Threshold for transition from good to marginal status. For Monitor Types with a sohValueType of DURATION a duration value will be give (e.g. "PT5M"). For Monitor Types with a sohValueType of PERCENT a numeric value will be give (e.g. 5).	

3.3.6 Channels Used in SOH Status by SOH Monitor Type

The soh-control.channels-by-monitor-type configuration lists the Channels which rollup to the Station Worst Of Monitor Value and Status for a specific Monitor Type. The results for the TIMELINESS, LAG, and MISSING Monitor Types are displayed on the Station Statistics Display. The results for individual types of Environmental Monitors are not displayed on any display but are combined into one and displayed on the Station Statistics Display. By default, all Channels

roll up for all Monitor Types for all Stations. Thus, the soh-control.channels-by-monitor-type configuration is the only soh-control processing configuration file for soh-control which does not contain a default configuration file. If there are no Station specific overrides, then the gms-common/config/processing/soh-control.channels-by-monitor-type folder will be empty (or possibly with a .gitkeep file).

config/processing/soh-control.channels-by-monitor-type/overrides.json

Configuration Option			
Name	description		
Default {MonitorType(s)}	Optional configuration options each for a specific Station for soh-control.soh-threshold configuration object.		
constraintType	criterion	operator	description
STRING	StationName	EQ	name of station to which this configuration option applies
parameters		type	description
MISSING		string list	list of channels
LAG		string list	list of channels
TIMELINESS		string list	list of channels
ENV_AUTHENTICATION_SEAL_BROKEN		string list	list of channels
ENV_BACKUP_POWER_UNSTABLE		string list	list of channels
ENV_CALIBRATION_UNDERWAY		string list	list of channels
ENV_CLIPPED		string list	list of channels
ENV_CLOCK_DIFFERENTIAL_TOO_LARGE		string list	list of channels
ENV_DEAD_SENSOR_CHANNEL		string list	list of channels
ENV_DIGITIZER_ANALOG_INPUT_SHORTED		string list	list of channels
ENV_DIGITIZER_CALIBRATION_LOOP_BACK		string list	list of channels
ENV_DIGITIZING_EQUIPMENT_OPEN		string list	list of channels
ENV_EQUIPMENT_HOUSING_OPEN		string list	list of channels

ENV_EQUIPMENT_MOVED	string list	list of channels
ENV_GPS_RECEIVER_OFF	string list	list of channels
ENV_GPS_RECEIVER_UNLOCKED	string list	list of channels
ENV_MAIN_POWER_FAILURE	string list	list of channels
ENV_VAULT_DOOR_OPENED	string list	list of channels
ENV_ZEROED_DATA	string list	list of channels

3.3.7 Monitor Types Included in Station Status Rollup

The soh-control.monitor-types-for-rollup-station configuration defines Monitor Types which will roll up for the Station Worst Of Status which is displayed on the SOH Overview and Station Statistics displays. When a Monitor Type is not included in the Rollup for Station Status that Monitor Type appears in dark grey on the Station Statistics Display (as opposed to the color for the Status). For a list of Monitor Types which can be included see the SOH Value and Status section.

config/processing/soh-control.monitor-types-for-rollup-station/default.json

Configuration Option			
Name	description		
default	The default configuration option for soh-control.monitor-types-for-rollup-station		
constraintType	criterion	operator	description
DEFAULT	—	—	defines the constraint as default
parameters		type	description
sohMonitorTypesForRollup		string list	list of monitor types for roll up (see Appendix A for a list of valid Monitor Types)

config/processing/soh-control.monitor-types-for-rollup-station/{station}.json

Configuration Option	
Name	description

{station(s)}		Optional configuration options for soh-control.monitor-types-for-rollup-station that are specific to a Station		
constraintType	criterion	operator	description	
STRING	StationName	ANY	name(s) of stations to which this applies	
parameters		type	description	
sohMonitorTypesForRollup		string list	list of monitor types for roll up (see Appendix A for a list of valid Monitor Types)	

3.3.8 Monitor Types Included in Channel Status Rollup

The soh-control.monitor-types-for-rollup-channel configuration defines Monitor Types which will roll up for the Channel Worst Of Status. The Channel Worst Of Status is not displayed on the UI nor used in any other calculation. A default.json file is required all other files are optional overrides.

config/processing/soh-control.monitor-types-for-rollup-channel/default.json

Configuration Option				
Name	description			
default	The default configuration option for soh-control.monitor-types-for-rollup-channel			
constraintType	criterion	operator	description	
DEFAULT	—	—	defines the constraint as default	
parameters		type	description	
sohMonitorTypesForRollup		string list	list of monitor types for roll up (see Appendix A for a list of valid Monitor Types)	

config/processing/soh-control.monitor-types-for-rollup-channel/{station}.json

Configuration Option		
Name	description	

{station(s)}		Optional configuration options for soh-control.monitor-types-for-rollup-channel that are specific to one or more Stations		
constraintType	criterion	operator	description	
STRING	StationName	ANY	name(s) of stations to which this applies	
parameters		type	description	
sohMonitorTypesForRollup		string list	list of monitor types for roll up (see Appendix A for a list of valid Monitor Types)	

config/processing/soh-control.monitor-types-for-rollup-channel/{channel}.json

Configuration Option				
Name		description		
{channel(s)}		Optional configuration options for soh-control.monitor-types-for-rollup-channel that are specific to one or more Channels on a single Station		
constraintType	criterion	operator	description	
STRING	StationName	EQ	name of station to which this applies	
STRING	ChannelName	ANY	name(s) of Channels to which this configuration option applies	
parameters		type	description	
sohMonitorTypesForRollup		string list	list of monitor types for roll up (see Appendix A for a list of valid Monitor Types)	

3.3.9 Channel Capability Rollup

The soh-control.channel-capability-rollup configuration object configures the Channel Capability Status. The Channel Capability Status is calculated based upon the Channel Monitor Status's of the various Monitor Types. The Channel Capability Rollup configuration specifies which Monitor Types to include and which operator type (BEST_OF, WORST_OF,

MIN_GOOD_OF) to use when calculating the Channel Capability Status. The Channel Capability Status is not displayed on the UI but is used to calculate the Station Capability Status.

The Channel Capability Status rolls up the statuses from one of the following:

- 1) The Channel Monitor Status' for the Monitor Types listed in sohMonitorTypeOperands; or
- 2) The results of the sub rollups given by rollupOperatorOperands (which will include an operatorType and list of Monitor Types for it's sohMonitorTypeOperands); or
- 3) The Channel Monitor Status' for all Monitor Types when neither the sohMonitorTypeOperands nor rollupOperatorOperands are provided

config/processing/ soh-control.channel-capability-rollup/default.json

Configuration Option			
Name	description		
default	The default configuration option for soh-control.channel-capability-rollup		
constraintType	criterion	operator	description
DEFAULT	—	—	defines the constraint as default
parameters		type	description
sohMonitorsToChannelRollupOperator		Complex Channel Capability Rollup structure	Complex structure which describes how to calculate the Channel Capability Status. Structure is described below.

config/processing/ soh-control.channel-capability-rollup/overrides.json

Configuration Option			
Name	description		
{station group}	Optional configuration options for soh-control.channel-capability-rollup that are specific to Station Group(s)		
constraintType	criterion	operator	description

STRING	StationGroupName	ANY	name(s) of station groups to which this applies
parameters		type	description
sohMonitorsToChannelRollupOperator		Complex Channel Capability Rollup structure	Complex structure which describes how to calculate the Channel Capability Status. Structure is described below.
Configuration Option			
Name	description		
{station group station}	Optional configuration options for soh-control.channel-capability-rollup that are specific to Station Group(s) Station(s)		
constraintType	criterion	operator	description
STRING	StationGroupName	ANY	name(s) of station groups to which this applies
STRING	StationName	ANY	name(s) of stations to which this applies
parameters		type	description
sohMonitorsToChannelRollupOperator		Complex Channel Capability Rollup structure	Complex structure which describes how to calculate the Channel Capability Status. Structure is described below.
Configuration Option			
Name	description		
{station group station channel}	Optional configuration options for soh-control.channel-capability-rollup that are specific to Station Group(s), a Station, and Channel(s)		
constraintType	criterion	operator	description
STRING	StationGroupName	ANY	name(s) of station groups to which this applies
STRING	StationName	EQ	name of station to which this applies

STRING	ChannelName	ANY	name(s) of Channel to which this applies
parameters		type	description
sohMonitorsToChannelRollupOperator		Complex Channel Capability Rollup structure	Complex structure which describes how to calculate the Channel Capability Status. Structure is described below.

The complex structure for Channel Capability Rollup is composed of the following:

parameters	type	description
operatatorType	string	Type of operation that the rollup calculation will perform. Valid values are: <ul style="list-style-type: none"> BEST_OF - The best status (GOOD is better than MARGINAL, MARGINAL is better than BAD) WORST_OF - The worst status (BAD is worse than MARGINAL, MARGINAL is worse than GOOD) MIN_GOOD_OF - Count of the number of status' included in the roll up which are good compared to the goodThreshold and marginalThreshold.
goodThreshold	integer	Number of Monitor Types with a GOOD Channel Monitor Status required to make the Channel Capability Status GOOD. The goodThreshold is only included if the operatorType is MIN_GOOD.
marginalThreshold	integer	Number of Monitor Types with a GOOD Channel Monitor Status required to make the Channel Capability Status GOOD. The goodThreshold is only included if the operatorType is MIN_GOOD.

parameters	type	description
sohMonitorTypeOperands	string list	Provides a list of Monitor Types to include in the Channel Capability Rollup. The sohMonitorTypeOperands is optional, if it is provided then the rollupOperatorOperands should not be provided, if neither is provided then ALL Monitor Types are included.
rollupOperatatorOperands	Complex Channel Capability Rollup structure	Provides two or more sub rollups to include in the Station Capability Rollup. The rollupOperatorOperands is optional, if it is provided then the channelOperands should not be provided, if neither is provided then ALL Stations in the Station Group are included. Each sub rollup includes: 1) operatorType (plus goodThreshold and marginalThreshold if the operatorType is MIN_GOOD_OF) 2) sohMonitorTypeOperands giving list of Stations

3.3.10 Station Capability Rollup

The soh-control.station-capability-rollup configuration object configures the Station Capability Status. The Station Capability Status is calculated based upon the Channel Capability Status's. The Station Capability Rollup configuration specifies which Channels to include and which operator type (BEST_OF, WORST_OF, MIN_GOOD_OF) to use when calculating the Station Capability Status. The Station Capability Status is displayed on the SOH Overview and Station Statistics display.

The Station Capability Status rolls up the statuses from one of the following:

- 1) The Channel Capability Status' for the Channels listed in channelOperands; or
- 2) The results of the sub rollups given by rollupOperatorOperands (which will include an operatorType and list of Channels for it's channelOperands); or
- 3) The Channel Capability Status' for all Channels for the Station when neither the channelOperands nor rollupOperatorOperands are provided

config/processing/soh-control.station-capability-rollup/default.json

Configuration Option			
Name	description		
default	The default configuration option for soh-control.station-capability-rollup		
constraintType	criterion	operator	description
DEFAULT	–	–	defines the constraint as default
parameters		type	description
channelsToStationRollupOperator		Complex Station Capability Rollup structure	Complex structure which describes how to calculate the Station Capability Status. Structure is described below.

config/processing/soh-control.station-capability-rollup/overrides.json

Configuration Option			
Name	description		
{station group}	Optional configuration option for soh-control.station-capability-rollup which is specific to a Station Group Name. If used, then the configuration options for soh-control.station-capability-rollup which are specific to only a Station.		
constraintType	criterion	operator	description
STRING	StationGroupName	ANY	name(s) of station groups to which this applies
parameters		type	description
channelsToStationRollupOperator		Complex Station Capability Rollup structure	Complex structure which describes how to calculate the Station Capability Status. Structure is described below.
Configuration Option			

Name		description	
{station}		Optional configuration option for soh-control.station-capability-rollup which is specific to a Station. If used, then configuration options for soh-control.station-capability-rollup which are specific to only a Station Group only should not be used.	
constraintType	criterion	operator	description
STRING	StationName	ANY	name(s) of stations to which this applies
parameters		type	description
channelsToStationRollupOperator		Complex Station Capability Rollup structure	Complex structure which describes how to calculate the Station Capability Status. Structure is described below.
Configuration Option			
Name		description	
{station group station}		Optional configuration option for soh-control.station-capability-rollup which is specific to a Station Group Name and Station	
constraintType	criterion	operator	description
STRING	StationGroupName	ANY	name(s) of station groups to which this applies
STRING	StationName	ANY	name(s) of stations to which this applies
parameters		type	description
channelsToStationRollupOperator		Complex Station Capability Rollup structure	Complex structure which describes how to calculate the Station Capability Status. Structure is described below.

The complex structure for Station Capability Rollup is composed of the following:

parameters	type	description
operatatorType	string	Type of operation that the rollup calculation will perform. Valid values are: <ul style="list-style-type: none">• BEST_OF - The best status (GOOD is better than MARIGNAL, MARIGNAL is better than BAD)• WORST_OF - The worst status (BAD is worse than MARGINAL, MARGINAL is worse than GOOD)• MIN_GOOD_OF - Count of the number of status' included in the roll up which are good compared to the goodThreshold and marginalThreshold.
goodThreshold	integer	Number of Channels with a GOOD Channel Capability Status required to make the Station Capability Status GOOD. The goodThreshold is only included if the operatorType is MIN_GOOD.
marginalThreshold	integer	Number of Channels with a GOOD Channel Capability Status required to make the Station Capability Status GOOD. The goodThreshold is only included if the operatorType is MIN_GOOD.
channelOperands	string list	Provides a list of Channel Names to include in the Station Capability Rollup. The channelOperands is optional, if it is provided then the rollupOperatorOperands should not be provided, if neither is provided then ALL Stations in the Station Group are included. The stationOperands can only be included if the configuration option is constrained to a specific Station Group.

parameters	type	description
rollupOperatatorOperands	Complex Station Capability Rollup structure	Provides two or more sub rollups to include in the Station Capability Rollup. The rollupOperatorOperands is optional, if it is provided then the channelOperands should not be provided, if neither is provided then ALL Stations in the Station Group are included. The rollupOperatorOperands can only be included if the configuration option is constrained to a specific Station. Each sub rollup includes: 1) operatorType (plus goodThreshold and marginalThreshold if the operatorType is MIN_GOOD_OF) 2) channelOperands giving list of Stations

3.3.11 Station Group Capability Rollup

The soh-control.station-group-capability-rollup configuration object configures the Station Group Capability Status. The Station Group Capability Status is calculated based upon the Station Capability Status's. The Station Group Capability Rollup configuration specifies which Station to include and which operator type (BEST_OF, WORST_OF, MIN_GOOD_OF) to use when calculating the Station Capability Status. The Station Group Capability Status is displayed on the SOH Overview display.

The Station Group Capability Status rolls up the statuses from one of the following:

- 1) The Station Capability Status' for the Stations listed in stationOperands; or
- 2) The results of the sub rollups given by rollupOperatorOperands (which will include an operatorType and list of Stations for it's stationOperands); or
- 3) The Station Capability Status' for all Stations in the Station Group when neither the stationOperands nor rollupOperatorOperands are provided

config/processing/ soh-control.station-group-capability-rollup/default.json

Configuration Option		
	Name	description

default	The default configuration option for soh-control.station-group-capability-rollup		
constraintType	criterion	operator	description
DEFAULT	—	—	defines the constraint as default
parameters		type	description
stationsToGroupRollupOperator		Complex Station Group Capability Rollup structure	Complex structure which describes how to calculate the Station Group Capability Status. Structure is described below.

config/processing/soh-control.station-group-capability-rollup/overrides.json

Configuration Option			
Name	description		
{station group name}	A configuration option for soh-control.station-group-capability-rollup that is specific to a Station Group		
constraintType	criterion	operator	description
STRING	StationGroupName	ANY	name(s) of station groups to which this applies
parameters		type	description
stationsToGroupRollupOperator		Complex Station Group Capability Rollup structure	Complex structure which describes how to calculate the Station Group Capability Status. Structure is described below.

The complex Station Group Capability Rollup structure is defined below:

parameters	type	description
operatatorType	string	Type of operation that the rollup calculation will perform. Valid values are: <ul style="list-style-type: none">• BEST_OF - The best status (GOOD is better than MARGINAL, MARGINAL is better than BAD)• WORST_OF - The worst status (BAD is worse than MARGINAL, MARGINAL is worse than GOOD)• MIN_GOOD_OF - Count of the number of status' included in the roll up which are good compared to the goodThreshold and marginalThreshold.
goodThreshold	integer	Number of Stations with a GOOD Station Capability Status required to make the Station Group Capability Status GOOD. The goodThreshold is only included if the operatorType is MIN_GOOD.
marginalThreshold	integer	Number of Stations with a GOOD Station Capability Status required to make the Station Group Capability Status GOOD. The goodThreshold is only included if the operatorType is MIN_GOOD.
stationOperands	string list	Provides a list of Station Names to include in the Station Group Capability Rollup. The stationOperands is optional, if it is provided then the rollupOperatorOperands should not be provided, if neither is provided then ALL Stations in the Station Group are included. The stationOperands can only be included if the configuration option is constrained to a specific Station Group.

parameters	type	description
rollupOperatatorOperands	Complex Station Group Capability Rollup structure	Provides two or more sub rollups to include in the Station Group Capability Rollup. The rollupOperatorOperands is optional, if it is provided then the stationOperands should not be provided, if neither is provided then ALL Stations in the Station Group are included. The rollupOperatorOperands can only be included if the configuration option is constrained to a specific Station. Each sub rollup includes: 1) operatorType (plus goodThreshold and marginalThreshold if the operatorType is MIN_GOOD_OF) 2) stationOperands giving list of Stations

3.4 ACEI Merge Processor

3.4.1 Merge Tolerance

The ACEI Merge Processor Merge Tolerance configuration object configures the time tolerance for two ACEI objects to be apart and still be merged together into a single object. The ACEI data will be merged together when the difference in there time is less than or equal to the merge-tolerance-ms.

Note that for PI13 the ACEI Merge Processor does not utilize the configuration in the processing config.

config/processing/acei-merge-processor.merge-tolerance-ms/default.json

Configuration Option			
Name	description		
default	The default configuration option for acei-merge-processor.merge-tolerance-ms		
constraintType	criterion	operator	description
DEFAULT	—	—	defines the constraint as default
parameters	type		description
merge-tolerance-ms	milliseconds (numeric)		Tolerance in milliseconds for which ACEIs will be merged when less than or equal to the tolerance.

config/processing/acei-merge-processor.merge-tolerance-ms/overrides.json

Configuration Option				
	Name	description		
	{station name(s)}	A configuration option for acei-merge-processor-tolerance-ms that applies to specific Stations		
	constraintType	criterion	operator	description
	STRING	StationName	ANY	name(s) of station to which this applies
	parameters	type		description
	merge-tolerance-ms	milliseconds (numeric)		Tolerance in milliseconds for which ACEIs will be merged when less than or equal to the tolerance.
Configuration Option				
	Name	description		
	{station channel name(s)}	A configuration option for acei-merge-processor-tolerance-ms that applies to specific Channel		
	constraintType	criterion	operator	description

STRING	StationName	IN	name of station to which this applies
STRING	ChannelName	ANY	name(s) of Channel to which this applies
parameters	type	description	
merge-tolerance-ms	milliseconds (numeric)	Tolerance in milliseconds for which ACEIs will be merged when less than or equal to the tolerance.	

3.5 SOH Display

3.5.1 Default User Preferences

There is a defaultUserPreferences.json file which defines the default layout for the display. This file is not a processing configuration files and thus does not have constraints.

config/user-preferences/defaultUserPreferences.json

parameter name	type	description
defaultLayoutName	string	Name of the default Layout
sohLayoutName	string	Name of the default Layout
userID	string	Value is defaultUser
workspaceLayouts	Complex Workspace Layout Structure List	List of one or more Complex Structure detailing out the workspace layout

Each Complex Workspace Layout Structure is comprised of:

parameter name	type	description
name	string	Name of the Layout
supportedUserInterfaceMode	string list	List of User Interface Modes which the layout can be used for. Valid values include SOH and ANALYST
layoutConfiguration	string	Layout of the tabs. Note this is not easily human readable.

4 UPDATING CONFIGURATION

4.1 System Config

The default set of system configuration values are built-in to the SOH system and should generally not be changed. If required, individual system configuration values may be overwritten. Environment variables, provided to the system via **gmskube** on initial deployment, can be specified to override any value.

Environment variables names are restricted to only alphanumeric characters and an underscore. By convention, environment variable names are specified with upper-case characters. System configuration names must be translated into a corresponding environment variable names to specify them for override. The transformation rules are:

1. The prefix "GMS_CONFIG_" is added to the name to avoid collision with other potentially identical environment variables.
2. The characters are all converted to upper case to match the UNIX convention.
3. Any dash character "-" is replaced with a single underscore "_".
4. Any dot "." character is replaced with two underscores "__".

For example, to override the value of `cd11-rsdf-processor.retry-backoff-ms`, the environment variable `GMS_CONFIG_CD11_RSDF_PROCESSOR__RETRY_BACKOFF_MS` would be specified.

To specify this override when starting the system, it would be provided via a `--env` argument to **gmskube**. Any number of overrides can be specified, just by specifying multiple `--env` arguments. To override `cd11-rsdf-processor.retry-backoff-ms` to 2 seconds, the following would be specified in the deployment command:

```
$ gmskube install -env GMS_CONFIG_CD11_RSDF_PROCESSOR__RETRY_BACKOFF_MS=2000 ...
```

4.2 Other Configuration

The default set of *processing configuration*, *station reference*, *station processing*, and *user preferences*, will automatically be loaded when a new instance of the system is freshly deployed.

These processing config files are *expected* to be organized in this following subdirectories under a top-level configuration directory:

- **processing**
This directory contains processing configuration used to configure processing components in the system.
- **station-reference/stationdata**

This directory contains several JSON files that contain the Common Object Interface (COI) representations of *station reference* configuration and *station processing* configuration. Note that these files *should not be edited* directly, but should instead be generated from a set of source CSS-formatted files in **station-reference/data**

- **user-preferences**

This directory contains a JSON file which specifies the user preferences for the user interface.

4.2.1 Overrides

The *processing configuration*, *station reference*, *station processing*, and *user preferences* can be overwritten at startup by providing an alternate set of configuration files in the directory structure specified above.

The path to the top-level directory of this alternate configuration can be specified via the `--config` argument to **gmskubede install**. Note that the alternate set of files may be sparse – any directories *not* found in the overrides will fall back to default values in the default configuration.

```
% gmskubede install --config path-to-my-configuration ...
```

After the system has been initially deployed, the *processing configuration* can be updated by running **gmskubede reconfig**. Note that on update, most SOH components will be automatically *restarted* to use the new configuration. The updated processing config must be specified under a *processing* subdirectory, matching the same directory structure specified above.

```
% gmskubede reconfig --config path-to-my-configuration ...
```

In addition to *processing config*, a new *station-reference/stationdata/processing-station-group-definition.json* file can also be included in the configuration to update the station group definitions. It is important to note that *no other configuration* will be updated as part of a reconfig.

4.2.2 Generating Station Reference and Station Processing from CSS

To update station reference and station processing configuration, you should first edit the CSS specification files found in your override copy of the *station-reference/data* directory. After updates/changes have been made to those CSS files, the **gms-css-to-coi** program can be used to generate the station reference and station processing configuration JSON files:

```
$ gms-css-to-coi -s path-to-my-config/station-reference/data -d path-to-my-config/station-reference/stationdata
```

This conversion must be done prior to running **gmskubede install** with the `-config` argument for your alternate configuration to be read. Again, note that this configuration is not updated on a **gmskubede reconfig**.

5 SOH PROCESSING CONFIGURATION GUIDANCE

This section provides recommendations for SOH configuration values, including the Reprocessing Interval, the Redisplay Interval, the Acknowledgement Quiet Duration, the list of Available Quiet Durations, and then for each Channel Monitor the Good Threshold, Marginal Threshold, Calculation Interval, and the Back Off Duration.

5.1 Definitions

Max Time to Process SOH Calculations – This is the maximum amount of time required to process the SOH calculations. Determining the actual value would require benchmarking the system and would depend upon the number of stations and channels being processes. Value should be less than 1 second.

Trend Display Acceptable Performance Limit – The duration of time which the Trend Displays can return before the performance becomes unacceptable.

Packet Length – This is the length of the packet. For CD1.1 packets this is 10 seconds.

Minimum Latency – This is minimum latency experienced by the Channel.

Minimum Normal Latency – This is the minimum latency which is considered normal for the Channel.

Maximum Normal Latency – This is the maximum latency which is considered normal for the Channel. For determining defaults use the Maximum Normal Latency of any Channel covered by the defaults.

Sample Frequency – This is the frequency at which the data is sampled on the Channel

n – Several of the calculations below specify n. Any positive non-zero integer can be used as n to satisfy the equation. The number used for n in one equation does not have to relate to the number used for n in a different equation.

5.2 SOH General Configuration Parameters

5.2.1 Reprocessing Interval

The Reprocessing Interval is a duration specified in seconds, minutes, or hours and it must be a positive number.

Reprocessing Interval > Max Time to Process SOH Calculations

The Reprocessing Interval cannot be faster than the time required to process SOH Calculations. Failure to set the Reprocessing Interval to be higher than the Max Time Required to Process SOH Calculation may result in the system failing to work properly.

5.2.2 Acknowledgement Quiet Duration

The Acknowledgement Quiet Duration is a duration specified in seconds, minutes, hours, or days.

Acknowledgement Quiet Duration >= 0

Setting the Acknowledgement Quiet Duration interval to 0 will mean that there is no quiet interval following acknowledgement.

Acknowledgement Quiet Duration \geq MAX(Calculation Interval)

This is a loose recommendation. Setting the Acknowledgement Quiet Duration to be greater than the Calculation Interval will give enough time for all data in the current calculation window to be filtered through during the quiet interval. Since there is only one acknowledgement interval and yet the Calculation Interval is per Channel Monitor it may be desirable to throw out especially high Calculation Intervals.

5.2.3 Available Quiet Durations

The Available Quiet Duration are a list of durations specified in seconds, minutes, hours, or days.

Available Quiet Duration $>$ Reprocessing Period

If a duration on the list of Available Quiet Duration is not greater than the reprocessing period, then it might not be quieted after the next update.

Available Quiet Duration \geq MAX (Calculation Interval + Back Off Duration)

It is recommended that at least one available quiet duration is greater than the maximum Calculation Interval plus Back Off Duration. This allows the user to select a quiet interval which is long enough for all current data to be filtered out.

5.2.4 SOH Station Stale Duration

The SOH Station Stale Duration is the time duration before the UI declares the data outdated.

SOH Station Stale Duration $>$ Reprocessing Period

The SOH Station Stale Duration should be greater than the reprocessing period otherwise under normal processing might be declared old.

5.2.5 SOH Historical Durations

The SOH Historical Duration is a list of durations for easy selection on the Trend displays.

SOH Historical Duration \gg Reprocessing Interval

All SOH Historical Durations should be a large magnitude longer than the Reprocessing Interval. If the SOH Historical Duration is 50 times longer than the Reprocessing Interval, then it will display 50 points on the graph.

SOH Historical Duration \gg Calculation Interval

All SOH Historical Durations should be significantly greater than the shortest Calculation Interval and the largest SOH Historical Duration should be significantly longer than the longest Calculation Interval. Selecting a SOH Historical Duration

that is less than the Calculation Interval will result in the averages being calculated using SOH values that cover less time than the original data covered by the SOH values.

SOH Historical Duration \leq Trend Display Acceptable Performance Limit

All Historical Durations should be less than the Trend Display Acceptable Performance Limit otherwise the performance on the trend display would become unacceptable with a default selection.

5.3 Channel Monitor Configuration Parameters**5.3.1 Calculation Interval**

The Calculation Interval is a duration specified in seconds, minutes, or hours and it must be a positive number.

Calculation Interval \geq Reprocessing Interval

If the Calculation Interval is less than the Reprocessing Interval, then there can be received data which will not affect any SOH calculation

Calculation Interval \geq Packet Length

It is recommended that the Calculation Interval be greater than or equal to the Packet Length.

5.3.2 Back Off Duration

The Back Off Duration is a duration specified in seconds, minutes, or hours and it must be a non-negative number.

Back Off Duration ≥ 0

Setting the Back Off Duration to zero will mean that the end of the calculation window is equal to the Calculation Time. For the Missing Data Monitor this will result in data which currently in route under normal latency or going to be included in a packet which has not yet passed its end time to be reported as missing; thus 0 for the Back Off Duration is not recommended for the Missing Data Monitor.

Back Off Duration \geq Maximum Normal Latency + Packet Length - Calculation Interval

Failing to meet this requirement may result in no data being included in the calculation even under normal conditions. This means under normal conditions it's possible for 100% of data will be considered missing, and latency and environmental issues will be reported as Unknown.

Back Off Duration \geq Maximum Normal Latency + Packet Length

In order to ensure consistent sampling of data the back off duration should be greater than the maximum normal latency plus the packet length such that

under normal circumstances data has been received for the entire calculation interval. For the Missing Data Monitor if this condition is not met then data which is not expected to be received while operating under normal condition will be treated as missing (this would include data which has not been received due to normal latency and data which had not been received because it part of a packet being currently created on the system). This is less important for the Latency and Environmental Monitors; however, if this condition is not met it means the amount of data used in the calculation will be less that the Calculation Interval suggests should be included.

5.3.3 Good Threshold

For the Timeliness Monitor Type:

The Good Threshold for the Timeliness Monitor Type is a duration specified in seconds, minutes, or hours and it must be a non-negative number.

Good Threshold \geq Maximum Normal Latency + Packet Length

The reason to do this is to keep data with the normal latency range as reporting good Timeliness.

Good Threshold = Maximum Normal Latency + Packet Length

The reason to do this is to keep data with the normal latency range as reporting good Timeliness and data outside the normal latency range reporting as marginal Timeliness.

For the Lag Monitor Type:

The Good Threshold for the Lag Monitor Type is a duration specified in seconds, minutes, or hours and it must be a non-negative number.

Good Threshold \geq Maximum Normal Latency

The reason to do this is to keep data within the normal latency range as reporting good Lag.

Good Threshold = Maximum Normal Latency

The reason to do this is to keep data within the normal latency range as reporting good Lag and data outside the normal latency range reporting as marginal.

For the Missing Data Monitor Types:

The Good Threshold for the Missing Data Monitor Type is a percentage between 0 and 100.

Good Threshold $\geq 1/(\text{Packet Length} * \text{Sample Frequency})$

The ending time of a packet is the time of the last sample of data in that packet, the starting time of the next packet is the time of the first sample of data in that packet. The time in between the first sample in the next packet and the last sample in the previous packet is not accounted for and ends up being counted as Missing. This is a very minimal amount, but enough that the Good Threshold should not be set to 0% as this will result in the data always being marginal.

Good Threshold < 100%

Setting the Good Threshold to 100% would mean that data is always good and never Marginal or Bad. Note that this might be desirable.

For Environmental Issues Monitor Types:

The Good Threshold for the Environmental Issues Monitor Type is a percentage between 0 and 100.

Good Threshold >= 0%

Setting the Good Threshold to 0 will mean that having any single environmental bit set within the calculation window will cause the SOH Status for that Environmental Monitor to be Marginal or Bad.

Good Threshold < 100%

Setting the Good Threshold to 100% would mean that data is always good and never Marginal or Bad. Note that this might be desirable.

5.3.4 Marginal Threshold**Marginal Threshold > Good Threshold**

If the Marginal Threshold was less equal to the Good Threshold the Status will never be Marginal. In some cases, this may be a desirable outcome to only have Good and Bad in which case setting the Marginal Threshold to be equal to the Good Threshold is acceptable.

For the Timeliness Monitor Type:

The Marginal Threshold for the Timeliness Monitor Type is a duration specified in seconds, minutes, or hours and it must be a non-negative number.

For the Lag Monitor Type:

The Marginal Threshold for the Lag Monitor Type is a duration specified in seconds, minutes, or hours and it must be a non-negative number.

Marginal Threshold << Calculation Interval + Back Off Duration

Late arriving data does not affect the SOH Calculations. Thus, data that is more latent than the Calculation Interval plus the Back Off Duration will not

affect the Lag Calculation. Thus, it is recommended that the Marginal Threshold be significantly less than the Calculation Interval plus the Back Off Duration to ensure the Lag Monitor can be BAD (the exact definition of significantly is subjective).

For the Missing Data Monitor Types:

The Marginal Threshold for the Missing Data Monitor Type is a percentage between 0 and 100.

Marginal Threshold < 100

If the Marginal Threshold was set to 100 then the Status would never be BAD. In some cases, it might be desirable in which case setting the Marginal Threshold to 100 is acceptable.

Marginal Threshold \geq Good Threshold + [(Packet Length/Calculation Interval) * 100]

In this equation the Packet Length/Calculation Interval is equal the effect of 1 packet on the equation (this could have also been expressed as $[1/(\text{Calculation Interval}/\text{Packet Length})]$). It is recommended that the Marginal Threshold and Good Threshold are further apart than the effect of a single packet on the equation otherwise the equation would could only calculate out to be Marginal if the packet with missing data was either a partial packet at the beginning or ending of the calculation window or the Channel Reported only partial data for the packet.

For Environmental Issues Monitor Types:

The Good Threshold for the Environmental Issues Monitor Type is a percentage between 0 and 100.

Marginal Threshold < 100

If the Marginal Threshold was set to 100 then the Status would never be BAD. In some cases, it might be desirable in which case setting the Marginal Threshold to 100 is acceptable.

Marginal Threshold \geq Good Threshold + [(Packet Length/Calculation Interval) * 100]

In this equation the Packet Length/Calculation Interval is equal the effect of 1 packet on the equation (this could have also been expressed as $[1/(\text{Calculation Interval}/\text{Packet Length})]$). It is recommended that the Marginal Threshold and Good Threshold are further apart than the effect of a single packet on the equation otherwise the equation would could only calculate out to be Marginal if the packet with the set environmental issue

was either a partial packet at the beginning or ending of the calculation window.

5.4 General Recommendations

SOH processing configuration may be customized as needed for the station, channel, and monitor type. For simplicity in understanding, default configuration should be defined at the highest level possible, and only customized when needed for effective processing. For example:

1. Set the Calculation Interval the same across all monitors types.
2. Set the Back Off Duration the same across all monitor types.
3. Set the Good Threshold and Marginal Threshold the same for all Environmental Issues Monitor Types.
4. Set all Monitor Types to roll up for each Channel.
5. Set all Monitor Types to roll up for each Station.

5.4.1 PI13 Default Config Parameters

Processing and display values:

Reprocessing Interval: 20 seconds

Acknowledge Quiet Duration: 5 minuets

Available Quiet Interval: 5 minutes, 15 minutes, 1 hour, 24 hours, 7 days

SOH Station Stale Duration: 5 minutes

SOH Historical Durations: 6 hours, 12 hours, 24 hours

All Stations

backOffInterval: 5 minutes

calculationInterval: 10 minutes

Timeliness:

goodThreshold: 5 minutes

marginalThresold: 15 minutes

Lag:

goodThreshold: 5 minutes

marginalThresold: 15 minutes

Missing:

goodThreshold: 2%

marginalThresold: 10%

Environmental:

goodThreshold: 0%

marginalThresold: 75%

6 APPENDIX A

The following table gives a list of Monitor Types and the corresponding Result Type.

Monitor Type	SOH Value Type
MISSING	PERCENT
LAG	DURATION
TIMELINESS	DURATION
ENV_AUTHENTICATION_SEAL_BROKEN	PERCENT
ENV_BACKUP_POWER_UNSTABLE	PERCENT
ENV_CALIBRATION_UNDERWAY	PERCENT
ENV_CLIPPED	PERCENT
ENV_CLOCK_DIFFERENTIAL_TOO_LARGE	PERCENT
ENV_CLOCK_DIFFERENTIAL_IN_MICROSECONDS*	DURATION
ENV_DEAD_SENSOR_CHANNEL	PERCENT
ENV_DIGITIZER_ANALOG_INPUT_SHORTED	PERCENT
ENV_DIGITIZER_CALIBRATION_LOOP_BACK	PERCENT
ENV_DIGITIZING_EQUIPMENT_OPEN	PERCENT
ENV_EQUIPMENT_HOUSING_OPEN	PERCENT
ENV_EQUIPMENT_MOVED	PERCENT
ENV_GPS_RECEIVER_OFF	PERCENT
ENV_GPS_RECEIVER_UNLOCKED	PERCENT
ENV_LAST_GPS_SYNC_TIME*	DURATION
ENV_MAIN_POWER_FAILURE	PERCENT
ENV_STATION_POWER_VOLATAGE*	DURATION
ENV_VAULT_DOOR_OPENED	PERCENT
ENV_ZEROED_DATA	PERCENT

*Note that there are three Environmental Monitor Types with a SOH Value Type of DURATION. These Monitor Type are not currently being calculated.