

Recommendation for Standardized Data Logger State of Health Reporting

FDSN WG-V
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Preface

The diversity of instrumentation used in portable broadband deployment presents challenges when monitoring network performance with disparate state-of-health (SOH) available from data loggers. SOH reporting varies from regularly sampled time-series, to on demand reporting, to periodic recording to a text file on local media. These varying reporting methods and inconsistent SOH across data loggers, challenges operators of both real-time and stand-alone (on-site recording only) networks to have a unified approach when assessing network status. By adopting recommended SOH, the FDSN can encourage manufacturers to standardize SOH reporting and simplify network operations.

Currently several manufacturers have either released or are about to release new data loggers. Several of these new data loggers have enhanced SOH reporting, but still there is limited commonality across manufacturers. Below is recommend SOH information that data loggers should report to enhance an operators' ability to troubleshoot network problems.

Recommendation

1. Time series and/or sampled SOH channels (see attached table)

Where appropriate we'd expect these channels to be stored as mseed time series data

Component	State of Health	Time series	sps	On query/power-up
Total system				
	system input voltage	x	0.1	x
	system current	x	0.1	x
Sensor system				
	voltage	x	0.1	x
	current	x	0.1	x
	mass positions	x	0.1	x
	temperature	x	0.1	x
	Sensor tilt	x	0.1	x
	Calibration	x		

Digitizer system				
	voltage	x	0.1	
	internal battery voltage	x	0.1	
	current	x	0.1	
	temperature	x	1	
	humidity	x	1	
	pressure	x	0.1	
	Resets			x
	Reboots			x
	data buffer used			x
	data buffer capacity			x
	memory used			x
	memory capacity			x
	CPU load average			x
	media writes			x
Storage				
	used bytes			x
	available bytes			x
	capacity bytes			x
Telemetry				
	link status			x
	input - cumulative bytes over time window			x
	output - cumulative bytes over time window			x
	buffer used			x
	buffer capacity			x
	packets dropped or tossed by digitizer			x
Timing				
	Clock quality 100% <5 μ s, 90% < 100 μ s, 70% < 200 μ s, 1% decrement for each hour free running	x		
	Number of satellites used			x
	GPS Latitude	x	0.00005	
	GPS Longitude	x	0.00005	
	GPS Elevation	x	0.00005	
	GPS Lock Status	x		
	GPS PLL Status	x		
	GPS Antenna status			x
	Clock phase error	x	1	
	GPS antenna current	x	1	
	GPS time	x		
	GPS module current	x		
	GPS module voltage	x		
	VCO voltage	x	0.1	
	NTP/PTP delay	x	0.1	x
	NTP/PTP offset	x	0.1	x
	NTP/PTP jitter	x	0.1	x

2. Log File (non-time series, e.g. on power-up or on request)

Stored as mseed log channels. All entries time stamped.

2.1. DAS configuration and configuration updates (e.g. sample rate(s), sensor centering threshold values, gain settings, telemetry, etc.)

2.2. Hardware

2.2.1. DAS serial number

- 2.2.2. DAS components HW version
- 2.2.3. DAS components FW version
- 2.2.4. DAS component serial #
- 2.2.5. DAS nominal bit weight
- 2.2.6. sensor serial number
- 2.2.7. sensor manufacturer & model
- 2.2.8. sensor FW
- 2.2.9. sensor nominal sensitivity
- 2.2.10. GPS serial number
- 2.2.11. GPS FW version
- 2.2.12. GPS model/HW version
- 2.2.13. media serial number
- 2.2.14. media HW
- 2.2.15. media FW
- 2.2.16. VCO nominal drift rate
- 2.3. SOH Information
 - 2.3.1. All Errors, warnings, state changes. (see Section 3. Examples below)
 - 2.3.2. sensor orientation
 - 2.3.3. GPS – number of satellites tracked and constellation used
 - 2.3.4. digitizer system clock resyncs time and value
 - 2.3.5. media present, not present, formatted
 - 2.3.6. sensor control line activity

3. Example error/warnings for log file

- 3.1. Total system
 - 3.1.1. System input voltage below programmed threshold
 - 3.1.2. Power lost: Low-voltage disconnect (LVD)
 - 3.1.3. Whenever an operational limit is close, such as low/high temp or low/high voltage, buffer full, etc. i.e. anything that will cause the unit to stop acquiring data.
 - 3.1.4. If unit erases or can't find user configuration or reverts to a default configuration.
 - 3.1.5. Power ups.
- 3.2. Sensor system
 - 3.2.1. Mass re-center with flag for cause
 - 3.2.1.1. Automatic – triggered by mass reaching a threshold
 - 3.2.1.2. Programmed – scheduled mass re-center
 - 3.2.1.3. Manual – user requested
- 3.3. Digitizer system
 - 3.3.1. Acquisition started/stopped
 - 3.3.2. Acquisition disabled due to full RAM/buffer
 - 3.3.3. Calibration ON/OFF
 - 3.3.4. Self-calibration offset and gain per channel
- 3.4. Storage

3.4.1. Write to media failed (with reasons: low power, failed to create file system, media services being suspended on low voltage, etc.)

3.4.2. Media full (warnings at certain thresholds, 80% full, 90%, etc.)

3.5. Telemetry

3.5.1. Link status change

3.6. Timing

3.6.1. GPS when NMEA string absent

3.6.2. GPS when 1PPS absent

3.6.3. When drift corrections are absent

3.6.4. GPS and OSC differ by $\geq \pm 1\text{sec}$