

SENTINEL SmartPole

Pole-tilt and structural-motion monitoring, in two configurations

Monitor lean, sway and shock on utility poles, masts, light standards and similar slender structures. **SmartPole LTE** sends data from each node directly to the secured cloud enclave over LTE-M, in either of two operating modes switched from the portal. **SmartPole Mesh** (coming soon) reports over a LoRa mesh to an on-site Sentinel hub that forwards data to the cloud, with no per-node cellular subscription required for routine reports and alerts.

Continuous

Tilt and motion monitoring

62.5 Hz

Primary three-axis waveforms

45 s

Default pre-event waveform history

16 MB

Onboard waveform storage

CONFIGURATIONS AT A GLANCE

	 SmartPole LTE	 SmartPole MESH COMING SOON
Best for	City use where LTE-M coverage is available.	Remote sites; no LTE required.
Path to cloud	Each node direct to the secured cloud enclave; no local gateway.	Nodes report directly or through neighboring nodes to one on-site hub per cluster; the hub forwards to the cloud over its internet backhaul (Starlink).
Per-node cellular	Required: LTE-M (Cat-M1) with the node's own SIM and data plan.	Not required for routine reports and alerts. Optional per-node LTE-M where a SIM is fitted.
Operating modes	Mode 1 (routine + event) and Mode 2 (continuous streaming), switched remotely from the portal.	Mode 1 (routine + event).
Waveform data	Mode 1: alert-triggered event capture with pre-event history. Mode 2: continuous waveform streaming over LTE-M (best-effort; gaps may occur).	Alert-triggered event capture stored at the sensor. A node with the optional per-node LTE plan can upload its waveforms; continuous streaming is not included.
Area imagery	Not specified.	The Sentinel hub can provide on-demand images of the area; images depend on camera placement and visibility.

OPERATING MODES

Mode	What the unit does	Availability
Mode 1: routine + event	Routine position reports, alert-triggered waveform capture with pre-event history, and resonance reports (cadences under Reporting & event capture).	SmartPole LTE and SmartPole Mesh.
Mode 2: continuous streaming	Continuous waveform streaming over LTE-M with TLS. Best-effort: gaps may occur and are accounted for.	SmartPole LTE only. Not available over the LoRa mesh.
Switching	Remotely from the portal, by authenticated command; the node reports whether the change was applied.	

SENSING & MEASUREMENT (BOTH CONFIGURATIONS)

Primary sensor	Three-axis precision accelerometer.
Motion / wake sensor	Six-axis inertial sensor; also a witness source.
Waveform sampling	Primary: 62.5 Hz, three-axis. Fallback: 52 Hz, magnitude.
Stored resolution	0.0625 mg per waveform count.
Reported measurements	Signed X / Y / Z acceleration in milli-g; peak tilt reported in degrees, in 0.1° increments.*
Tilt derivation	Averaged, settled gravity vector from three axes before a lean is declared.
Temperature	Optional ambient sensor, plus sensor and power-management die temperatures, reported in 0.5 °C increments.
Sensor selection	Automatic; each measurement identifies its sensor source.

*Reporting increments are not accuracy ratings. Mounting rigidity and the structure affect the measured tilt.

REPORTING & EVENT CAPTURE

Function	SmartPole LTE	SmartPole Mesh
Routine position report	Every 300 s by default; configurable 60–3600 s.	Every 300 s (5 min) by default; 60–3600 s by signed command.
Health report	Every 24 h by default; configurable 6 h–7 days.	Health and topology report every 24 h; 6 h–7 days.
Resonance / sway frequency	Every 24 h; cadence 6 h–6 days. Analysis window 90 s default, adjustable 20–90 s.	
Event waveform capture	Alert-triggered; 90 s by default, adjustable 90–1080 s in 90 s acquisition slots. Cellular required for upload.	
Pre-event waveform history	45 s before the alert by default; up to 90 s by operator command. Cellular required for upload.	
Continuous waveform streaming	Mode 2 only, over LTE-M; best-effort, gaps may occur.	Not included (Mesh runs Mode 1).
Post-alert observations	Not specified.	Every 15 s for 10 min; up to 40 points; enabled or disabled by command.
Temperature reporting	Every 300 s.	Not specified.
Optional check-in	Every 3 h; first check-in 15 s after boot. Enabled per deployment.	Not specified.

Events take priority over routine traffic: alerts trigger waveform capture and preserve pre-event history. Settings are adjusted through authenticated operator commands.

ALERT DEFAULTS (BOTH CONFIGURATIONS)

WARNING TILT 5%	TILT ALARM 10%	SWING ALARM 5%	SEVERE SWING 10%	SAFETY CEILING 45%
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Thresholds shown are defaults; the configuration ceiling cannot exceed 45%. Tilt is declared after the gravity vector is averaged and settled. A drop in sway frequency raises a separate low-resonance alert and can indicate loosening or reduced stiffness.

COMMUNICATIONS & NETWORK

Parameter	SmartPole LTE	SmartPole Mesh
Cellular link	LTE-M (Cat-M1), using the node's own SIM and data plan.	Optional per-node LTE-M where a SIM is fitted: event and pre-event waveform uploads, direct-to-cloud alert attempts, remote commands, and health reporting when isolated from the mesh. Shared LTE backup carries alerts only.
Mesh radio	Not applicable.	Sub-GHz LoRa point-to-point; not LoRaWAN. Direct hub links or neighboring-node relays.
U.S. frequency profile	LTE-M bands are carrier dependent; all major U.S. carriers supported.	902-928 MHz U.S. ISM band.
Channel access & relaying	Not applicable.	Listen-before-talk with bounded back-off; bounded, operator-controlled hop budget.
Range & sizing	LTE-M coverage verified at the mounting location.	Site survey required to validate range, hop count and node density. No guaranteed distance is specified.
Site hub	None; no local gateway required.	One hub per cluster, with mains or equivalent power and internet backhaul. Stores records and relays readings and alerts. Requires active Starlink service and a clear view of the sky.
Data transport	Routine and event records: encrypted UDP, switchable to TCP/TLS by signed command. Waveform and pre-event uploads: TLS over TCP.	Routine reports and alerts ride the mesh to the hub, which forwards them to the cloud. Waveform uploads use the per-node cellular connection.
Position / time	GNSS shares the antenna path with cellular. Fixes are periodic, not continuous; clear sky is required.	Sky view where GNSS time or position is required. The hub's recovery requests also carry an authenticated clock reference.
Remote control	Authenticated, replay-protected commands; the node reports which command was applied and whether it succeeded.	Authenticated, replay-protected commands; acknowledgements echo a CRC-32C of the exact accepted command bytes.

SECURITY, INTEGRITY & DATA RETENTION

Capability	SmartPole LTE	SmartPole Mesh
Data protection	AES-128-CCM encryption and integrity protection for every measurement, with per-node keys. Bulk uploads also use TLS.	AES-128-CCM encrypts and authenticates the payload with per-node keys; altered or damaged records are rejected.
Frame & relay integrity	Not applicable.	CRC-32C checks each frame header and samples. Each hop authenticates under a shared network key; relays cannot read or alter sealed payloads.
Delivery assurance	Unacknowledged records survive reboot and power loss. Retries continue until authenticated cloud confirmation; duplicates and gaps are detectable.	Sent routine records remain in non-volatile storage across reboot and power loss. On a sequence gap the hub sends an authenticated re-ask naming the exact record, and the node resends only that record, within a bounded, rate-limited retry ladder.
Local retention	16 MB flash stores event captures for later cellular upload, including when service is temporarily unavailable.	
Alert clearing	Not specified.	Alerts clear only on authenticated cloud evidence; neither a hub acknowledgement nor a waveform upload clears an alert.

INSTALLATION & POWER

Requirement	SmartPole LTE	SmartPole Mesh
Mounting	Rigid clamp mounting; orientation calibrated at commissioning.	Rigid mounting with orientation calibration at commissioning. Sub-GHz antenna at each node and hub, with reasonable line of sight.
Node power	DC power or battery/solar. Built-in power management and charge monitoring; daily battery-voltage reporting.	
Operating power model	Continuous sensing; processor and modem sleep between activity.	Sensors and mesh receiver run continuously; the processor sleeps between interrupts. Optional cellular uses PSM/eDRX power saving.
Delphire supplies	DC power or battery/solar, data SIM and cellular antenna; LTE-M coverage verified at the mounting location. Customers may provide their own SIMs.	Site survey to confirm hub placement, wireless coverage and power.
Service sizing	Power and data plans sized for report intervals, alert frequency and waveform capture duration.	Confirm the power budget against the reporting and capture policy.
Enclosure rating, operating temperature, dimensions, battery life, certifications	To be confirmed. Contact us.	

Validation status and scope. Monitoring and alerting only: not failure prediction, actuation or automated control, although resonance and waveform data may provide pre-failure information or cues. Active field-soak validation is ongoing. Enclosure environmental ratings, certification status and long-term field endurance remain to be confirmed for deployment. Specifications subject to change; deployment configuration and validation status must be confirmed.

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