NANO

Debut NANO series is innovative GNSS trackers for wild animals. It uses long-range Bluetooth as the data transmission method, and incorporates a highly efficient solar unit and rechargeable battery, as well as multiple environment sensors and activity sensors. With a compact and slim shape, it also features power on-board computing capability.

BASIC SPECIFICATIONS

MODEL	NANO
Appearance	 (standard injection molding housing)
Battery Type	40mAh lithium polymer rechargeable battery with under/over-charge protection
Battery Life	Over 500 positions under optimal GNSS satellite view at 5-minute interval
Solar Type	GaAs solar unit (30% efficiency) with good performance under weak light
Housing	ABS & PC injection molding (standard), X-Glue (P1), or nylon 3D-printed (M1)
Color	Light brown for injection molding housing, white or customized for P1/M1
Antenna	External, 0.4mm titanium alloy with protective coating (by default)
GNSS Module	Precision: CEP (50%) 5m Maximum update rate: 10 Hz
Working Temperature	-20°C~60°C (enough for very cold winter if close to warm-blood animal body)
Waterproof	> IP 68 (2 ATM for injection molding)
Data Types	- GNSS: longitude, latitude, altitude, altitude (ellipsoid), course, satellite quantity - ENV: voltage, light intensity, temperature - ODBA (overall dynamic body acceleration) - ACC: x/y/z acceleration data (upon request) - Beacon: with Debut series gateway devices
Data Storage	Collected data will be stored in memory before transmission. - Flash memory: 32 MB - Regular data storage: 460 days at default setting (1h GNSS+1h ENV+10 min ODBA) - BOOST data storage: 280,000 pieces - ACC data storage: 28,700 pieces
Working Schedule	Programmable from 1 min
Firmware Upgrade	Instantly via INTELINK (Bluetooth)

TRANSMISSION

NANO utilizes long-range Bluetooth for data transmission. When paired with a professional gateway device like the HUB from Druid, NANO enables data downloading from distances of up to 1200 meters in an ideal field environment, meaning that both the NANO device and the HUB are 2 meters away from the ground, no obstacles in between, no electromagnetic interference, and the air is not too moist.

The good part of NANO is that every who has a mobile phone with Bluetooth function can scan for it using Ecotopia App, but access will be required for operating NANO or download data it collected.

TRANSMISSION BANDS

Specifications	INTELINK
Frequency Bands	2.4 GHz
Maximum Output Power	8 dBm (default)
Maximum Data Rate	1 Mbps/1 Mbps
Transmission Distance (ideal condition in field)	1200 m

TRANSMISSION STRATEGY

NANO is configured to broadcast its INTELINK (Bluetooth) signals all the time. Professional gateway devices, such as a HUB and TAG G, are usually configured to scan for INTELINK devices following a duty cycle pattern, say, 30s in every minutes. NANO can connect to them only when HUB or TAG G is at "ON" duty. This duty cycle is configurable.

Gateway device like a mobile phone, with Bluetooth activated, will be able to pick up a NANO immediately.

For certain NANO sub-models that requires battery saving and thus configured also to broadcast in duty-cycle mode, you may have to wait longer before it can be picked up by a gateway device.

SUB-MODELS

Name	Weight	Dimensions (LWD, antennae excluded)	Energy Supply
NANO	3.6±0.1g	36 x 13 x 9.5 (mm)	40mAh rechargeable by solar
NANO P1 [1]	2.0±0.1g	31 x 9.5 x 7.5 (mm)	15mAh rechargeable by solar
NANO M1 [2]	2.7±0.1g	33 x 11 x 8.5 (mm)	40mAh rechargeable by solar
NANO M1 lite	2.0±0.1g	33 x 11 x 8.5 (mm)	15mAh rechargeable by solar
NANO C1 2700 [3]	26.9±0.3g	58 x 18 x 18 (mm)	2700mAh primary battery
NANO C1 1300	22.5±0.3g	58 x 18 x 18 (mm)	1300mAh primary battery
NANO C4 P500 [4]	11±0.2g	44 x 15.5 x 16 (mm)	500mAh primary battery
NANO C3 180 [5]	11±0.2g	46 x 13.5 x 16 (mm)	150mAh rechargeable by magnetic touch
NANO C5 580 [6]	15.1±0.2g	45 x 14.5 x 18 (mm)	580mAh rechargeable by magnetic touch

Note: [1] P1 refers to the X-Glue sealing technique primarily aimed at reducing weight.

[2] M1 refers to a unique housing crafted from 3D-printed nylon material. This housing features a bee-hive and bottomless design, while all components are waterproofed using our X-Coating technique to exceed the IP68 standard.

[3] The "C" series denotes customized versions using NANO's PCBA with different energy supply options. Photo to the right shows NANO C1.

[4] Photo to the right shows NANO C4 P500.

[5] Photo to the right shows NANO C3 180.

[6] Photo to the right shows NANO C5 580.

ANTENNA OPTIONS

ANTENNA MATERIAL OPTIONS

| Type	Description	Weight Change
A	0.2mm titanium alloy wire with waterproof coating	- 0.1g
B	0.4mm titanium alloy wire with waterproof coating	Default [1]
C	0.8mm titanium alloy rope (7*7 wires braided)	+ 0.2g

ANTENNA ROOT PROTECTION OPTIONS

Type	Description	Weight Change
Default	Plastic tube	Default [2]
Extra strengthened	Spring with longer plastic tube	+ 0.3g

Note: [1] By default, 0.4 mm titanium alloy wire with waterproof coating is used, to achieve the balance between weight and toughness. The weight change of other options is calculated based on the default version. Generally, the thicker the antenna, the more resilient it is.

[2] By default, only plastic tube is used, to achieve the balance between weight and toughness. The weight change is calculated based on the default version.

In the below photos:

- the left shows default antenna (B)+ default antenna root protection;
- the right shows antenna material C + extra strengthened antenna root.
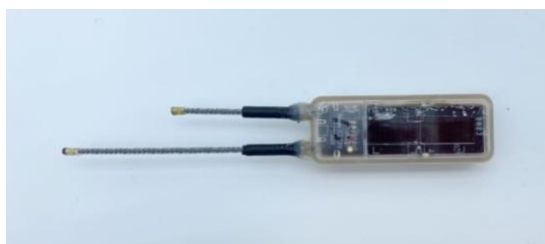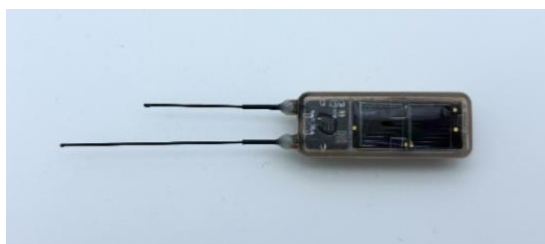
PRICING

Sub-Model	Device	(Feed Subscription)	Ecotopia Data Services [1]	Debut Renewal
	Retail	Promotion	(per unit per year)	Plan [2]
NANO	299	N/A	59.88	N/A
NANO P1	399	N/A	59.88	N/A
NANO M1	399	N/A	59.88	N/A
NANO M1 lite	399	N/A	59.88	N/A
NANO C1 2700	399	N/A	59.88	N/A
NANO C1 1300	399	N/A	59.88	N/A
NANO C4 P500	299	N/A	59.88	N/A
NANO C3 180	399	N/A	59.88	N/A
NANO C5 580	399	N/A	59.88	N/A

Note: The prices are in US dollar.

[1] To know more about Ecotopia Data Service, please click:

https://www.ecotopiago.com/help/en/#/essential/data_service/overview

[2] To know more about Debut Renewal Plan, please click:

https://www.youtube.com/watch?v=IM75JLGhsHU&t=6s

ATTACHMENT METHODS

NANO series is designed with flexible holes to support harness attachment on back or waist. The common accessories include:

- 1.5 mm UHMWPE tape, or 1mm silicon tubing
- Aluminum rings for binding harness (optional)
- 4 mm thick neoprene pad for elevation (so that thick feathers will not cover the solar panel)
-
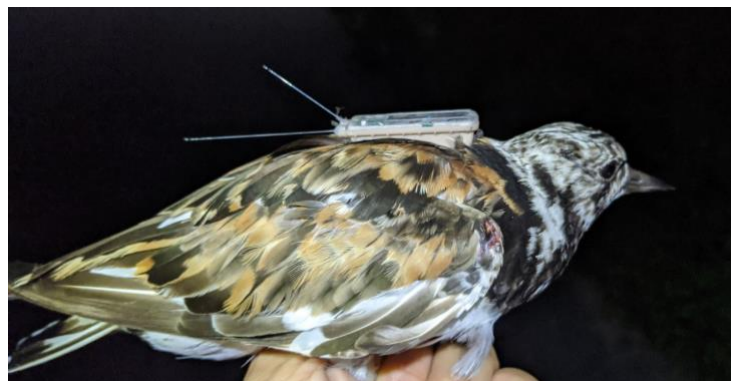
DATA SAMPLES

Equipped with a high-efficiency solar unit, NANO has the capability to gather hundreds of GPS data points daily. The screenshot below displays a 7-day GPS track recorded by a NANO unit attached to a tern, as it traversed the coast of Southeast Asia during mid-summer. Additionally, the accompanying small charts illustrate the variations in flying speed, altitude, light intensity, temperature, and activity index throughout this timeframe.
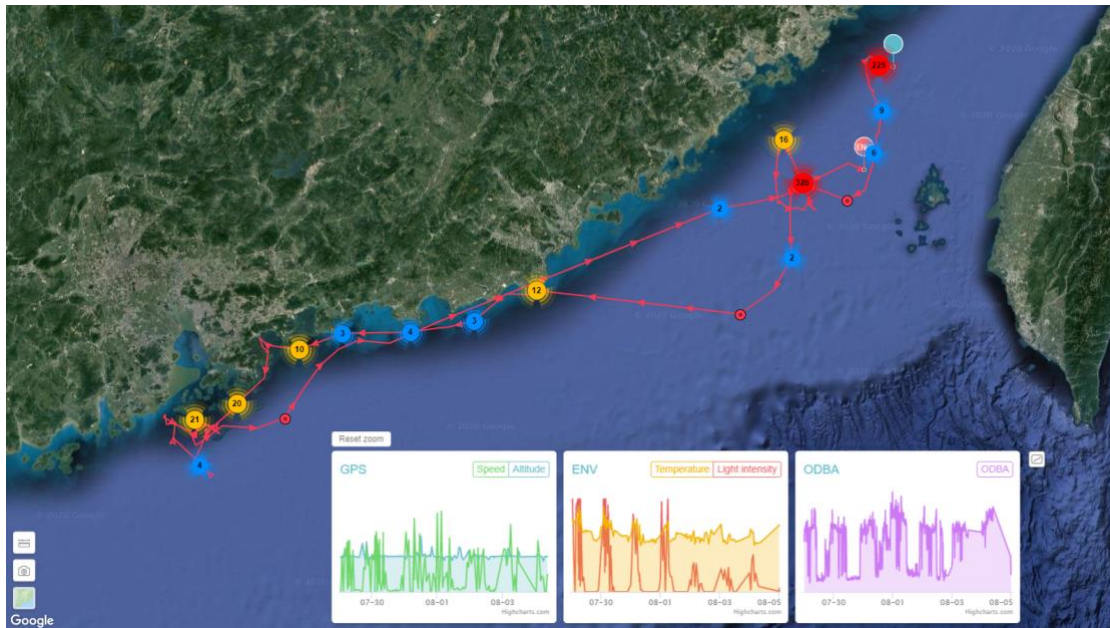

Below is the comprehensive migration trajectory of a tern, meticulously tracked by a NANO device over the course of 11 months, spanning over 70,000 GPS locations.
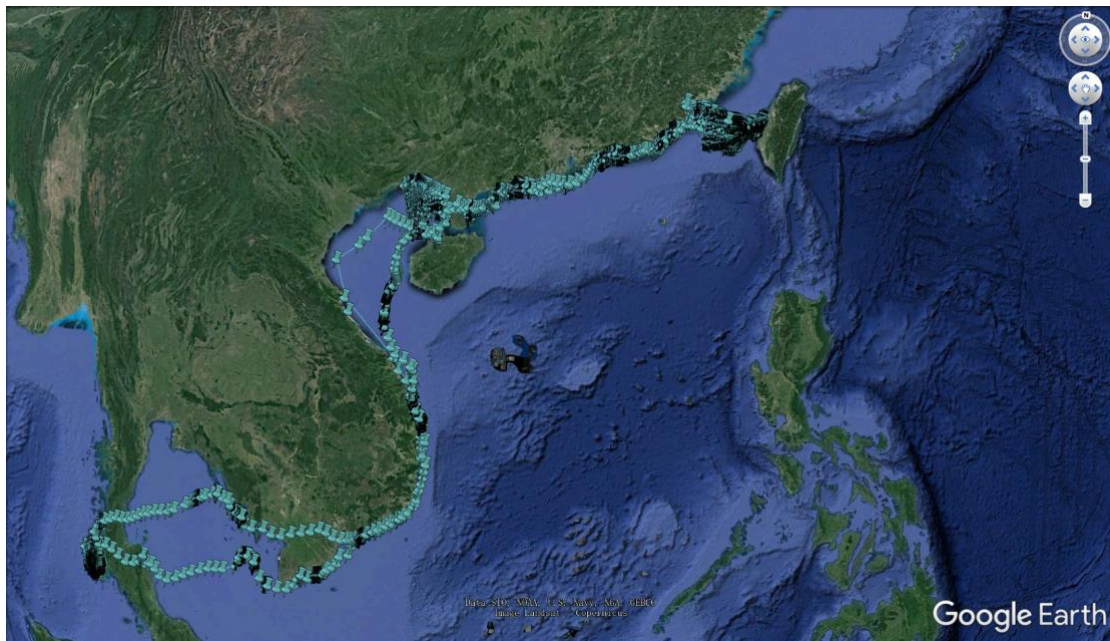
INTELINK: UBIQUITOUS NETWORKING

INTELINK®, derived from "intelligent linking," represents a patented communication technology rooted in Bluetooth innovation, distinguished by its extended range and remarkably low power consumption.

Empowered by INTELINK®, NANO seamlessly establishes connections with conventional smartphones and other Debut series products. This integration unlocks a myriad of additional functionalities, fostering the generation of novel data types through the interaction among diverse devices.
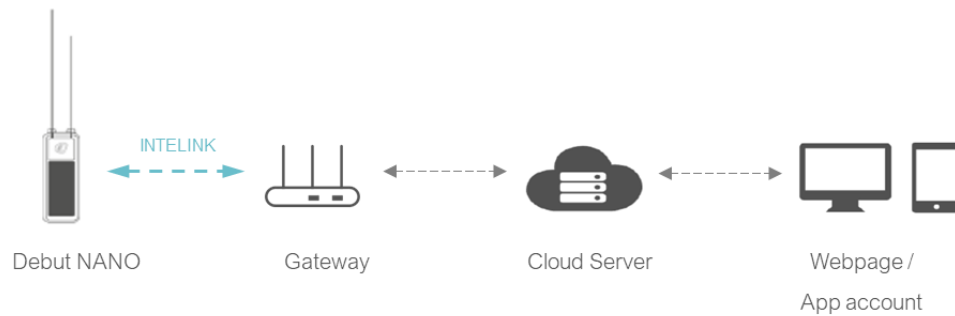
(For options of the gateway products, see page 13.)

DATA RELAY

Data gathered by NANOs can be retrieved by gateways through INTELINK, either through manual or automatic means.

Individuals with smartphones, using an authorized account, can easily scan for nearby NANOs and download stored data. This data is subsequently uploaded securely to the cloud server via the phone's network connection, whether it's cellular or Wi-Fi.

Alternatively, you can deploy a gateway at a fixed location in the field to continuously and autonomously scan for NANO devices. Once connected, the gateway will retrieve data from the NANO and automatically upload it via the cellular network.

BREEDING & NEST-USAGE RESEARCH

By situating a gateway near the nest, it will log the timestamps for when a NANO enters or exits its scanning zone. This yields important data for understanding nest usage and parenting strategies, particularly pertinent for breeding research purposes.


RAW ACCELERATION DATA

NANO possesses the capability to gather raw x/y/z acceleration data, ideal for behavioral research, particularly when synchronized with GPS, environmental variables, and individual activity patterns. Utilizing INTELINK, users can not only download raw acceleration data from the device memory, but also access real-time, continuous data by establishing a connection between the NANO and a gateway.

IN-SITU BEHAVIOR MODELING

When accessing real-time continuous raw acceleration data as described above, users can also annotate the data with behavior tags via the Ecotopia/IntelinkGO App.

With INTELINK facilitating the connection, real-time x/y/z acceleration data from the NANO linked to your phone is visualized on the phone screen via the Ecotopia/IntelinkGO App. Simultaneously, the App records videos using the phone's camera. While observing the birds through your phone, you can tap to apply behavior tags in real-time. These behavior tags, along with the data and video, are combined under precise timestamps and saved on your phone. Later, you can upload to webpage for subsequent analysis, further calibration, and validation.

x/y/x acceleration data

Behavior labeling

Video recording
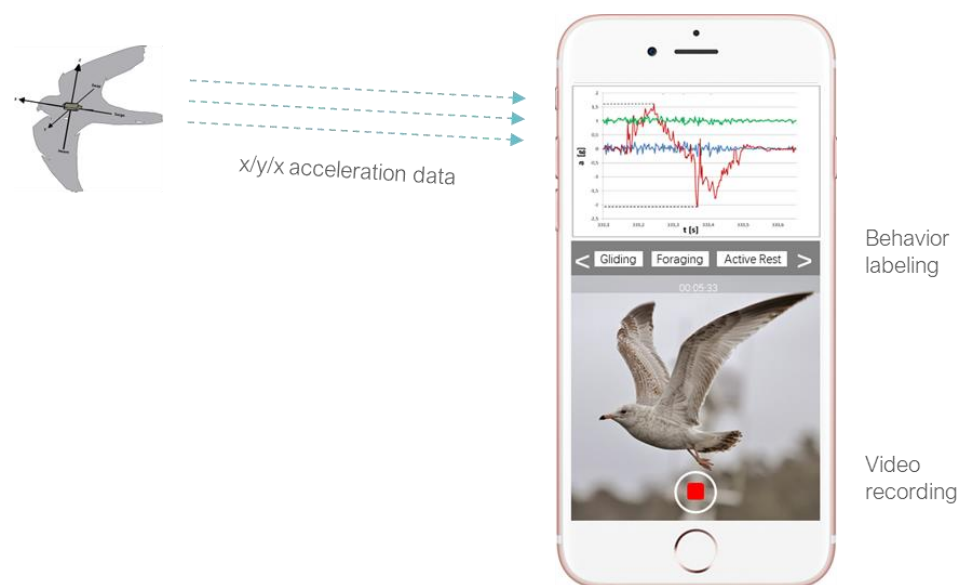
With the assistance of Druid's AniAct® behavior algorithm platform, users can create species-specific x/y/z acceleration-based behavior algorithms. Moreover, these algorithms can be uploaded back into the device and executed onboard. Subsequently, the device automatically processes acceleration data sampled at 25Hz or higher on board, and transmits behavior tags as the computation results.

This eliminates the need for users to compromise energy balance or incur high data fees to access raw acceleration data from distant locations. Additionally, it alleviates the burden of processing vast volumes of raw data, providing computed results effortlessly.

This functionality introduces a new dimension of data, offering fresh insights into bird research and conservation efforts.

GROUND SEARCH

Utilizing INTELINK technology alongside the Ecotopia/IntelinkGO, NANOs and smartphones seamlessly create a beacon system.

Activating the "Finding Device" feature within the App triggers an audible alert on the smartphone if a NANO is detected in proximity. The volume of the alert increases as the NANO gets closer, offering a convenient means to locate birds or fall-off devices in the field. Upon nearing the devices, users can effortlessly download all stored data as well.
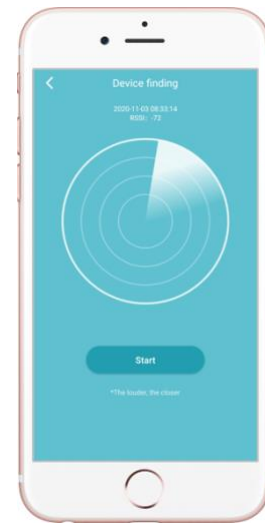
CITIZEN SCIENCE

INTELINK technology facilitates diverse interactions between bird tracking devices and smartphones, offering novel avenues for volunteers and the general public to contribute to scientific research and conservation efforts.

Here are some potential ways:

- With over 3 billion smartphone users worldwide, each device serves as a potential mobile "gateway". By simply tapping on the Ecotopia/IntelinkGO App to scan for birds in their vicinity, individuals can provide precise reports of bird resighting, including accurate location and time information. These reports are promptly forwarded to the relevant researchers, who can then share them within the species' online community.

- Beyond resighting reports, users can utilize the Ecotopia/IntelinkGO App to download/upload data stored in NANOs. Imagine the excitement for researchers when their data is safely updated by helpers they've never met.

- Advanced users can further contribute by applying behavior tags through the in-situ modeling function, drawing upon their own knowledge and observations. This collective input from participants worldwide could culminate in a shared database with varying levels of contribution, enriching research endeavors globally.

Visit the IntelinkGO webpage for more information: https://www.intelinkgo.com/.

GATEWAY PRODUCTS

The gateway can be an ordinary smart phone with Bluetooth function, or a Debut HUB, QUEST, or TAG G. Select the gateway that suit your project to go with NANOs.

Type	Photo	Range (Optimal)	Operation	Description
Phone		150m	Manual	Conveniently accessible anytime, anywhere, at no extra cost, the system taps into a vast potential network of over 3 billion mobile gateways across the globe.
Phone +QUEST		500m	Manual	A half-palm-sized rechargeable device (26 grams) engineered to extend the INTELINK range of a standard mobile phone.
Phone +QUEST III		700m	Manual	A Yagi antenna (62cm long, 230 grams) crafted to amplify the INTELINK range of a standard mobile phone. This is highly directional antenna, which is particularly suitable for ground searching tasks.
TAG G		600m	Manual / Auto	A palm-sized solar charging device (32g) designed for easy hanging in any garden area. Affordable enough to blanket every residential region, fostering citizen science projects.
HUB		1200m	Manual / Auto	A router-sized gadget (730 grams) encased in a robust metal housing, powered by battery, solar energy, or cable. Featuring high-resolution scanning capabilities, it stands as the most durable option for wilderness environments.