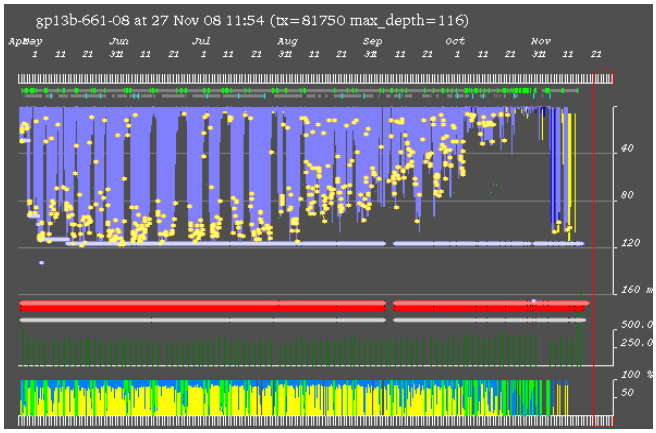
Argos & GPS/Argos SRDL Tags

We offer two Argos satellite-based tags: the standard Satellite Relay Data Logger (**SRDL**) and the **GPS SRDL.** What's special about these tags?

- Our tags are optimized to relay detailed *individual* dive and haulout data through the narrow Argos data bandwidth.
- The GPS version incorporates *Fastcat* technology to obtain at-sea, GPS-quality locations from surface periods of as little as 0.5 s
- We specialize in providing a bespoke service to address individual requirements in terms of both hardware and software configuration. We welcome new and interesting challenges! We also offer advice on planning and execution of tagging projects and the visualisation and analysis of the resulting data.



Grey seal SRDL data displayed on a Mamvis strip-chart window. Blue - individual dive information (profile, duration, surface time). Green - individual haulouts.

For more information please visit our web site at:
http://www.smru.st-and.ac.uk/Instrumentation

or contact:

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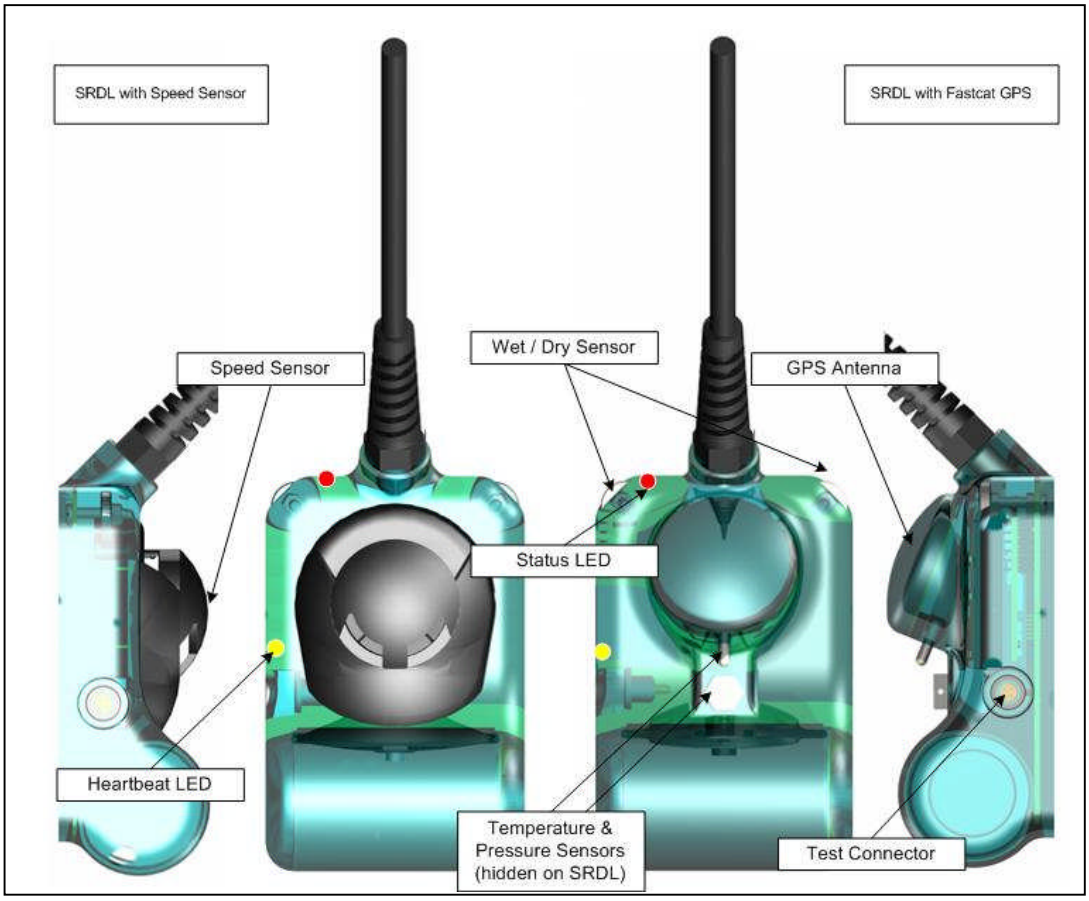
Physical Characteristics

Depth rating:	standard 500m, reinforced version 2000m
Standard sensors:	Pressure (resolution 5m @ 2000m, 0.5m @ surface) Wet/dry switch (can operate in salt or fresh water) Temperature (resolution 0.1^{o} C). The non-Fastcat GPS version is fitted with a turbine to provide an index of swim speed.
Memory:	If the tag is recovered then the *complete* temperature, dive and swim-speed datasets may be retrieved.
Transmitter:	TWIC RF module (0.5W), full 32-byte transmissions with built-in checksum.
Longevity:	Shelf life 10 years. Operational lifetime is determined mainly by number of transmissions attempted: e.g. 85,000 are possible spread over 1 year. The transmission scheduling can be set to extend longevity.

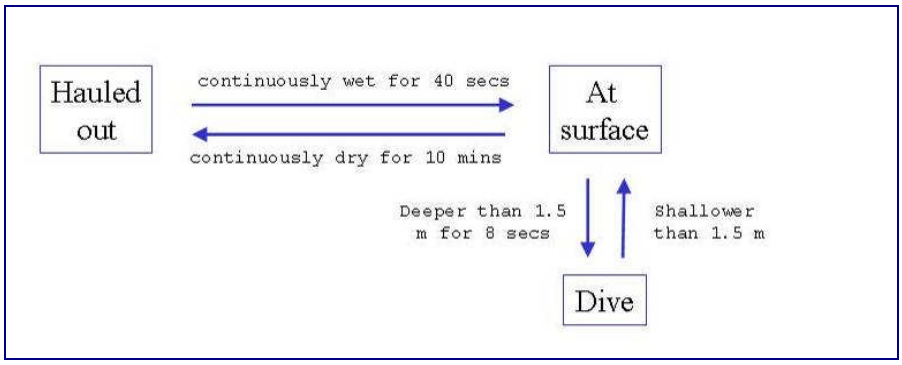


Data Structures

Below we describe in some detail the transmission formats of data structures. All parameters [in square brackets] can be changed to suit individual applications.

Behavioural states

The tag continually monitors the sensor data it is collecting and maintains a three-state model of the animal's activity, determined from surface sensor/depth sensor/ time interactions.



As the tag monitors transitions from one state to another, data records of two complementary types are constructed and made available for transmission.

Data types

Dive Record

Constructed at the end of each dive. When a dive begins, all the samples are accumulated at until the end of the dive is detected, creating a full-resolution dive profile. The tag then calculates the [9] internal points in the profile that give the best fit to the entire profile. Dives are transmitted in groups of consecutive dives. The timestamp refers to the most recent one – previous dives are positioned in time using the dive duration and surface duration fields. All other fields are optional. A post-dive surface duration exceeds [9] minutes, a termed a Cruise.

```
Time of start of last dive (required)
Dive Number
```
for each dive:
```
      Maximum depth
      Dive duration (required)
    Post-dive surface duration (required)
      Mean speed
      Dive index (%)
      Inflection points:
           Profile depth values
           Profile temperature values
           Profile speed values
           Residual of profile fit
```

Haulout Record

Constructed at the end of each haul-out. Haul-out (and Cruise) records simply contain the start- and end-times of unbroken periods spent in the "Hauled Out" (or "At Surface") states. These records require only a few bits to transmit but can account for long periods of the total data record.

```
Haulout Start (date-time)
Haulout End (end-time)
Haulout number (sequence, cycling 1 through 32)
```

Summary Record

Constructed for every [2] hours This contains summary statistics such as the proportion of time spent in each of the three states; the number of dives; mean, maximum and standard deviation of maximum dive depth; mean, maximum and standard-deviation of dive duration.

```
Summary period start (date-time)
% time in state Dive
% time in state Haulout
% time in state At Surface
Maximum depth
```

Temperature Cast Records

If a dive is one of the [2] deepest dives in each [2] hour period, the tag monitors the depth during the central phase and then collects temperature data at [1] second intervals on the ascent. Filtering and compression is performed by the conventional broken-stick method used for XBT casts, producing [12] temperature-depth pairs.

Data Relay

Many factors affect the ability of the tag to make a successful transmission (e.g. the animal's surfacing behaviour, proximity to other competing Argos devices, and satellite availability at different times of day). A buffering strategy is used to avoid the biases that this could introduce if data records were simply transmitted as they occurred. The tag maintains a circular buffer for each type of record. As each event record or summary record is created it is added to the next position in the appropriate buffer, displacing the oldest record. A separate pointer is maintained to the latest member of the buffer to have been transmitted, and this moves along one at a time as each new page is constructed. Provided that the buffer is large enough to smooth out fluctuations in the rate occurrence of the events, this simple mechanism ensures that each record has an equal chance of being received.

Power Budgeting

The power required for sampling and calculations is very small compared to transmissions. The lifetime of the tag is therefore controlled by restricting the number of transmissions that are attempted. Target points may be set at several dates, specifying the maximum number of transmissions that can be made by that time. The tag will restrict the number of transmissions made each day to keep itself on track to meet the next limit. If the behaviour of the animal means that the allowance is not used, restrictions are lifted temporarily.

For animals that haul out for extended periods it is often desirable to reduce the transmission rate during haul-outs, otherwise the number of Argos locations obtained at sea may be adversely affected. In haul-out, the tag increases the interval between transmissions to double the normal 40-45 seconds. After *3* hours a duty cycle of *5* hours quiet / *2* hours on is instigated. Note that it is only transmissions that are inhibited, the tag never switches itself off entirely and always maintains its 4 second basic sampling regime.

Satellite coverage varies considerably with time of day in some areas. It is therefore possible to prevent the tag from transmitting during those hours of the day when it is known that coverage is likely to be poor.