LoRaWAN® Mobile Applications: Blind ADR

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December 2019

LoRa® Device Mobility: An Introduction to Blind ADR

The LoRaWAN® adaptive data rate (ADR) mechanism slowly adapts the data rate between an end device ("end node") and a gateway depending upon the prevailing channel conditions[1]. Once established, the link is periodically maintained and removes much of the need for downlink confirmation messages to the end node. This makes it ideal for high capacity, static applications such as metering. However, for mobile applications where the channel conditions will change rapidly, we cannot use ADR.

In this article, we introduce the notion of blind ADR its purpose, and its advantages.

Consumption, Link Budget and Airtime

To see how to strike a balance between these conflicting requirements, we will consider a GPS-plus-LoRaWAN pet tracking application, where every 10 minutes the tracker wakes and sends its GPS status and coordinates, comprising 17 bytes. Wrapped in a LoRaWAN frame, this equates to a total of 30 bytes of packet payload. We assume that the battery will need to last for one year. If we were going to select a LoRa single data rate, we would have to choose from among the compromises outlined in Table 1.

Table 1

COVERAGE QUALITY	DEEP INDOOR	INDOOR	OUTDOOR
DATA RATE	SF12	SF10	SF7
BATTERY CAPACITY*	1092 mAh	392 mAh	136 mAh

**Battery capacity includes an estimate of the whole radio consumption.*

Because LoRa is a direct trade-off between link budget and time on air, deeper coverage comes at a cost of higher energy consumption. Achieving a high link budget with deep indoor coverage for our pet tracker will result in a higher power consumption cost, and a larger battery will be required due to the lower data rate. In contrast, the use of a smaller, cheaper battery would be possible if we use a high data rate, but at the cost of reduced coverage, as illustrated in Table 2:

Table 2

COVERAGE QUALITY	DEEP INDOOR	INDOOR	OUTDOOR	**ALL**
DATA RATE	SF12	SF10	SF7	**SF7, SF10, SF12**
BATTERY CAPACITY	1092 mAh	392 mAh	136 mAh	**383 mAh**

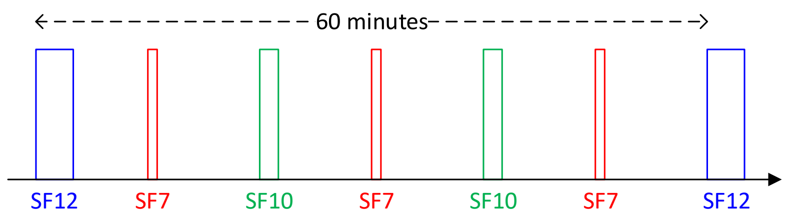
[1] For information on the standard ADR mechanism, network-based ADR, see the LoRa Adaptive Data Rate whitepaper.

Blind ADR: How Does It Work?

The purpose of blind ADR is to reject this fixed range-consumption trade-off of using a single data rate. Instead, we use a spread of data rates to gain both good coverage and long battery life. To see this in action, we will take the case of a GPS pet tracker using blind ADR.

Instead of using a single data rate, we use three data rates and different periodicity depending upon the data rate.

Figure 1



As illustrated in Figure 1, we will transmit at:

- SF12 once every hour,
- SF10 twice an hour, and
- SF7 three times an hour

For our pet tracking application, this gives us frequent outdoor position information when the pet is moving, with fewer updates when the animal is located indoors – and therefore, less mobile.

Advantages of Blind ADR

In this example application, blind ADR allows us to economize on battery life in a way that still meets the application's needs. Here, we retain the low power consumption of the application while maintaining frequent outdoor updates. Moreover, additional application intelligence and sensors or accelerometers are not required for deciding when to transmit.

Important Notice

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