LoRa - the Long Range protocol

LoRa is one of the four main communication protocols used on the Chirp network. It is one of the main IoT technologies used in the Blackbird, designed to provide very long range IoT coverage for communications or applications that require small data streams, on the order the bytes or kilobytes.

How does it work?

LoRa uses very narrow radio impulses, often called chirps, to send information, in a method called the chirp spread spectrum technique. This strategy is unique in its ability to resist against the influence of noise or jamming when in crowded radio channels, making it resilient to interference.

What is it for?

LoRa has a large number of uses, usually related to its use in collecting data from a very large number of different sensors across a very large area. This includes examples such as weather, air quality, pollution, light, temperature, humidity sensors, or switches such as one that checks whether a door is closed.

On networks such as Chirp where type C is enabled, devices are also listening all of the time for signals sent by gateways, so they can also respond to commands such as turning on lights, closing circuits, starting motors and moving valves. These devices tend to have a much lower autonomy than normal type A devices, so they will need to be recharged more often, or have their battery changed.

How does it compare?

LoRa has the best range and cost compared to all of the other IoT protocols. It provides coverage for millions of devices over very long ranges, up to hundreds of kilometers at a fraction of the price, using only open, license free frequency bands.

However, in terms of bandwidth and data rate it is below Wi-fi, BLE and cellular, altough recent advances in AI-based algorithms have achieved breakthroughs in enabling new advanced applications of LoRa such as image, video and audio transmission.

Compared to other technologies, LoRa offer deep indoor penetration, essentially being able to penetrate concrete walls or cover an entire office building.

LoRa, especially with the SX1303 advanced chipset, can provide extremely precise location detection of any sensor on the network, such as a simple temperature sensor, without GPS, at meter-level accuracy.

LoRa Hardware

What is a LoRa **Device**?

Small edge devices such as sensors, locators, or other IoT devices transmit these signals over a very long range, sometimes as far as hundreds of kilometers in the form of chirps representing individual bytes of data. Most edge devices are battery-powered, being capable of functioning for as long as 2 years without being recharged, and provide a variety of functions.

Some devices are also capable to receive commands through LoRa, when the LoRa network supports it, and may even take part in simple automation tasks such as starting motors or switching on a smart plug.

What is a LoRa **Gateway**?

Specialised LoRa hardware, called Gateways, receive the chirps emitted by edge devices and decode it into usable digital data. These Gateways are capable of processing signals with powers lower than that of background noise, all because of the shape of the chirp signal. Different pieces of information are sent by varying the time in between chirp signals.

Gateway optimise themselves by making use of spreading factors, a method to either extend their range of connecting to devices or the amount of data they can receive (datarate).

Gateways, such as Chirp’s Blackbird, use an antenna to capture the radio signal emitted by LoRa end devices. The antenna needs to be placed as high up as possible, in a place with great view and no obstructions in its surroundings. Another requirement of a LoRa Gateway is for it to be connected to the internet through either WiFi or Ethernet cables, which in the case of Chirp is also the source of electrical power, removing the need for a power cable.

Dual-band LoRa

LoRa frequency bands

Just like any other radio technology, LoRa has to operate within a imited range of radio frequencies. These frequency are often the unlicensed frequency, where the user does not need to seek approval from governmental institutions. Older technologies used to be limited to a single unlicensed band, called the sub-GHz band, which depended on which country, continent or region the devices were installed.

Chirp uses the latest improvements in LoRa technology that make it possible to use LoRa on the 2.4GHz Industrial, Scientific and Medical frequency band, a newer unlicensed frequency band designed for data transfer and which is also used by the majority of WiFi routers, Bluetooth, Zigbee.

The 2.4GHz frequency band makes it possible to send more data and makes all devices compatible with the same LoRa Gateway, regardless of where the device is installed.

Chirp offers dual-band LoRa, so you can make use of both the benefits of the longer range of the sub-GHz regional band, smoothly transition your devices from existing LoRa installations to the Chirp network, as well as make use of the advanced, higher data-rate and bandwith, 2.4GHz ISM LoRa.

How does LoRa handle interferrence?

Despite the fact that the 2.4GHz band is shared between multiple communication and data transfer protocols, the creators and developers of LoRa made it very resilient to interference by making it so LoRa chirps are situated right in the space in between the frequency bands of other protocols, as well as by making sure that LoRa uses very different specifications regarding how often, at what power, and how different the radio signals are transmitted compared to other technologies .

According to Semtech, the creators of the SX1280 chip that enabled 2.4GHz LoRa, the only way in which interference between LoRa and BLE can be created is if the two chips transmitting the full amount of data possible are less than a few centimeters from one another. ([The Immune System | Avoiding RF Interference with LoRa | DEVELOPER PORTAL (semtech.com)](https://lora-developers.semtech.com/documentation/tech-papers-and-guides/interference-immunity))

LoRa classes

What are the types of LoRa?

Besides the classification of LoRa on the basis of frequency, disgussed in [LoRa Frequency Bands], a LoRa-enabled network can also be classified according to the classes of devices that it supports, namely Class A, B or C.

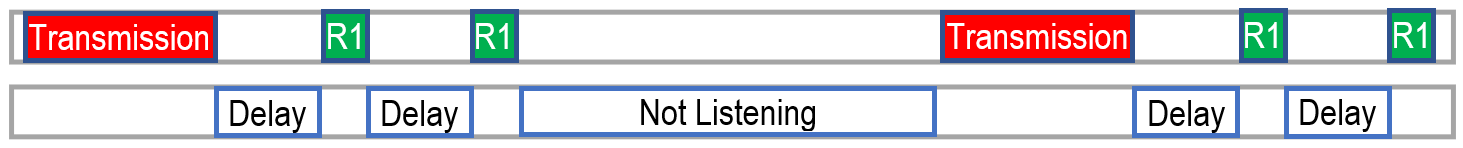
Altough all LoRa devices can communicate in both directions (receive and send messages), there is a difference in how often a device listens for messages sent from the Network/Cloud Applications through the Gateway that mediates between the internet and LoRa. Class A devices only listen in two short periods after its transmission window, Class B schedules additional receiving windows at fixed time periods regardless of whether transmissions were sent by the device in the meantime, and class C is always on, with the only exception being when the device itself is transmitting.

Classes B and C are not found in some of the popular, existing, networks in the IoT space. By enabling them from the get-go, Chirp extends the usability of its ecosystem by making the devices you can connect actually control the environment and respond to it, rather than just monitoring it and logging bytes when neccesary.

Altough support for Classes B and C is a network property, and it is enabled in part by Chirp’s use of a DLT blockchain architecture capable to scale to the amount of transmissions logged by a class B or C device, end devices themselves, as well as their firmware, needs to have class B and C operation set-up and enabled for it to work. Transition between classes is possible, and most devices have open-source firmware that can be edited or updated when needed to enable additional functionality and uses.

Class A

LoRa Type A is the simplest one, and the only one that older, legacy networks support.



Lora Type A devices are only capable to listen for a response from the Gateway after transmitting data during two open communication windows separated by a fixed delay. If the device does not receive anything in these limited windows of time when it is listening, it will not be able to receive anyhing until after it transmits data again and two new downlink windows are opened, identical to the previous ones.

The second Receive/downlink window is only openned in case nothing is received during the first window. It acts as a backup in case packets were lost or communication was not properly established.

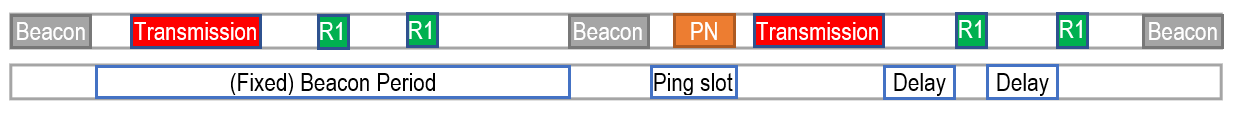
If anything is received during either downlink window, its duration extends until the full content of the received message is transmitted. The duration of the window is only fixed in the case where nothing is received.

Class A devices have the lowest energy consumption and tend to be battery powered with very long autonomy, up to years of operation. As the period in which they are not listening is arbitrary and they can only receive something after they transmit a signal themselves, they can be in sleep mode for the vast majority of their lifetimes. They have artificially high latency because of the arbitrary delays that separate downlink windows.

Example devices: a simple sensor, a a fixed period location tracking device, fire detection, cattle movement tracker.

Class B

LoRa Type B keeps the same behaviours as Type A devices, but in addition it schedules a special downlink window, called a Beacon, at fixed intervals, called the Beacon Period, that will be opened to receive data from the Cloud/Server Applications through a Gateway, regardless of whether or when the device sent a Transmission. When at the scheduled Beacon, an announcement that data will be sent to the device, a downlink period called the Ping slot is created.

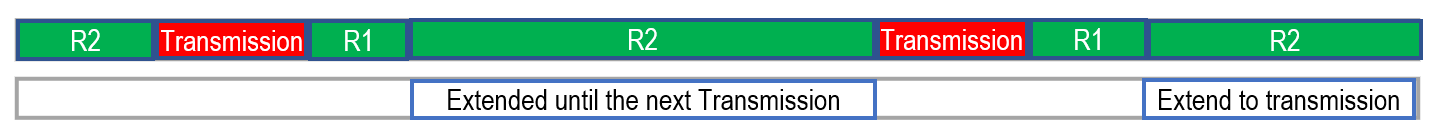


Unlike Type A devices which can have extremely long time periods where no up- or downlinks are created (no signals are sent or received from the device), a Type B device will always wake up to open a receive window for the scheduled Beacon transmissions. Even when no data is exchanged for long periods of time, the Beacon transmissions will still take place at the scheduled Beacon Periods.

This makes Type B devices more energy consuming but will lower latency and with the ability to push firmware upgrades, and they can switch to class A at any time. They are often used for applications such as smart utility meters, temperature reporting or accurate GPS location across time.

Class C

Class C devices are always on. Their receiving window is only stopped when they are transmitting themselves, and are otherwise always listening. They are the only ones that are usually plugged in rather than battery powered because of their increased power consumption, but have significantly reduced latency. This enables type C devices to control physical devices such as valves and switches in real time, opening and closing faucets, turning on and off streetlights, handling a smart irrigation system from a long distance or controlling plenty of other IoT devices.



Still in work

LoRa usage scenarios

Intro

Pizza delivery tracker

Cattle ranch livestock tracker

Weather model data acquisition

Smart Home automation – turning on/off heaters, Acs, ovens, heated blankets, light switches

Tracking shipments across oceans

Bluetooth Low Energy (BLE)

Bluetooth Low Energy (or BLE) is one of the most widely used wireless protocols in the IoT space, completely independent from classical Bluetooth and optimised for small devices with the same range as the original, which makes it a short range, 10-100m, protocol.

The usual BLE device can last somewhere in between a couple of months and a few years on a button cell battery, and they tend to be small and affordable.

The main driver of BLE adoption is the fact that it is compatible with the Bluetooth 4.0 chipsets installed on existing mobile phones and tablets. Some estimates show that up to 1-10 billion BLE devices might be currently in use.

Altough the usual BLE device has very short range but very long lasting battery life, it’s main benefit compared to LoRa or Zigbee is that it is much better optimised for the devices that need to send data often. It is easy to make a BLE device that sends lots of data on a higher frequency but at short range, with almost (but not exactly) continuous data streams possible for small durations or data burts. Compared to Bluetooth that has actual continuous connections, and is will most often be used for a wireless keyboard and mouse, some BLE applications also exist where battery is more important than the 100ms latency.

BLE uses the same 2.4 GHz radio frequency band as other protocols installed on the Blackbird, which makes it possible to share a single antenna with the other chipsets.

NOTE: Unlike classical Bluetooth, BLE has a much higher latency between connections (100ms compared to 6ms), a single BLE communication only transmits data in short bursts, it is not voice-capable, has a slightly lower datarate, but slightly higher than 2.4GHz LoRa.

BLE Applications

Applications include:

|  |  |
| --- | --- |
| MESH | Passing data short-range between devices across longer distances |
| Healthcare | * Blood Pressure * Health Thermometer Measurement Devices * Glucose Level Monitors * Continuous Glucode Level Monitors |
| Sports | * Body Composition Measurement * Cycling Speed and Cadence (sensors attached to bikes) * Cycling Power Profile (including exercise bikes) * Heart Rate Monitoring * Location, Navigation, Tracking using GPS |
| Environmental | * Enironmental Sensors * User Data Acquisition (e.g. heat in the room from a radiator) |
| Hardware | * Connecting a Keyboard (but not as precise due to latency) * Battery Level and Battery State of batteries in a device |
| Proximity | * Electronic Leash (check if another device goes out of range) * „Find Me!” (issues an alert on a second device) * Proximity estimation (detect if a connected device is close) |
| Audio (LE Audio) | * Headphones * Hearing Aids   (Lower Quality, better battery life compared to classic Bluetooth) |

Becase of the unique fact that BLE is installed on almost evert single smartphone built since 2012, it can create unique use cases that involve smartphones and beacons. A Beacon is a BLE enabled device that sends and receives BLE signals and can validate whether it should connect to a device using a unique ID. This makes it possible to directly target smartphones using BLE beacons, for example by sending off a notification or service some specific apps.

For example, a store can use this functionality to send users, who enable notifications from their app, a targeted promotional message as soon as they enter the store, or a welcome message, or a link to some useful information that they may need, such as where departments are located or where to find the closest customer service advisor.

Altough BLE can be used to assign unique IDs to real items using BLE tags, and a BLE Beacon (such as a Blackbird) can read off the tags to detect which item exists, it is not able to easily locate items up to meter-level accuracy due to it being limited to the use of RSSI

Zigbee

Similar to BLE, Zigbee is a short-range IoT protocol specialised in low-power radio devices at a range of 10 to 100m. Zigbee operates in the same 2.4 GHz ISM band as the other IoT protocols installed on the Blackbird. Unlike BLE and LoRa, the Zigbee module comes installed as an external, optional dongle that can be ommited when it is not required by a Blackbird’s Keeper.

Unlike BLE and LoRa, Zigbee is especially optimised for home automation, with its most common uses being in remote light switches, smart plugs, smoke and intruder detection, local sensors, and does not come with the same versatility as other IoT protocols.

Zigbee offers a capped data rate of 250 kbit/s, but it does not have the same long range properties of LoRa, as well as the ability to trade-off, when needed, between range, power consumption and data-rate, without external input, as dual-band LoRa. Neither does it have the ability to reach high data rates as BLE for the same range.

To put this comparison in numbers, BLE can reach up to 2Mbit/s in data rate, 8 times higher than Zigbee, whilst LoRa can reach 100-1000 times the range, and it’s not much different even when considering a configuration using the equivalent data rate.

However, the strong suit of Zigbee is that it was devised from the start to be easy to integrate in a Mesh Network, particularly suited for wireless control and monitoring, similar to LoRa class C. This makes it extremely simple to work with even if you are a complete stranger to IoT, and this simplicity made it a top IoT protocol for home low complexity home automation solutions, with more than 2 billion devices currently on the market.

Blackbird

## What is the Blackbird?

The Blackbird is Chirp’s flagship IoT Gateway, joining together in a single plug-and-play box all of the major IoT protocols: [**LoRa**](/chirpwireless/docs/-/blob/Chirp-Wiki/IoT-Protocols/LoRa/LoRa-intro.md) , [**BLE**](/chirpwireless/docs/-/blob/Chirp-Wiki/IoT-Protocols/BLE/BLE-intro.md) , [**Zigbee**](/chirpwireless/docs/-/blob/Chirp-Wiki/IoT-Protocols/Zigbee/Zigbee-intro.md) . The Blackbird doubles down as a IoT Gateway, an antenna device that provides wireless coverage for the IoT, as well as a Crypto miner.

To find out more about generating tokens, check out [**Generating Chirp Tokens**](/chirpwireless/docs/-/blob/Chirp-Wiki/Chirp-Tokens/blackbird-tokens.md)

## What is a Keeper

As each device that pays to connect to the Chirp Network routes its traffic through one of the user-installed Blackbirds around the world, and the traffic is transformed into rewards for the Owner and Operator of the Blackbird, its [**Keeper**](/chirpwireless/docs/-/blob/Chirp-Wiki/Chirp-Technology/keepers.md).

## What does the Blackbird do?

The Blackbird is a point of communication between IoT devices, which transmit radio signals containing a variety of data types and information, and the end-user. In essence, the Blackbird translates the language of the IoT (the communication protocols) and transforms it in a way in which it can be transmitted to the internet, and then understood and used by the [**Chirp Dashboard**](/chirpwireless/docs/-/blob/Chirp-Wiki/Chirp-Technology/dashboard.md), the webpage and mobile application where all of your IoT functionality is concentrated.

For the latter stage, different applications can be run remotely on the cloud using [**Cloud Applications**](/chirpwireless/docs/-/blob/Chirp-Wiki/Chirp-Technology/CLAs.md) and [**Smart Contracts**](/chirpwireless/docs/-/blob/Chirp-Wiki/Chirp-Technology/smart-contracts.md), and this will be further discussed on their own Wiki Entries.

## How can I become a Keeper?

Installing a Blackbird is simplified to its core, as it was entirely developed and designed in-house by the Chirp Team.

It functions as a plug-and-play device, connected to an antenna on one side, the internet through an ethernet cable or WiFi, and powered up using the same ethernet cable. Only on the Blackbirds operated using WiFi, a separate power cable needs to be connected.

For enthusiasts and maximizers, it is possible to use either the antenna provided in the kit or a custom one of your choosing, perhaps one that provides higher gain, is bigger or already installed.

# Blackbird Token Generation

## Chirp Tokens

\*\*[Blackbirds](../)\*\* are IoT \*\*[Gateways](../)\*\* as well and Chirp \*\*[Miners](../)\*\*, able to generate Chirp’s proprietary crypto token as rewards for providing IoT coverage for nearby users, or by facilitating the transfer of data and information on the Chirp Network.

## Proof-of-Coverage

The first method through which a Blackbird generates tokens, and the dominant way in which these will be distributed for the first few years from the launch of the Chirp Network, is Proof-of-Coverage.

This is a mechanism that rewards users for providing IoT coverage in a way that can be validated and proven by other Gateways or Master Gateways on the Chirp Network, even when no IoT user uses the network to transfer data around this time.

The validation process involves an algorithm where multiple Blackbirds interact in order to test the validity of each one of them, in addition to a series of validation tests on the internet connection and through GPS.

## Data Transfer Rewards

\*\*[Blackbirds]()\*\* listen for IoT devices that communite with the Chirp Network using either one of the installed communication protocols. When a connection is established, and data is transferred from an IoT device to a Blackbird, to be then interpreted and sent through the internet, the Keeper that owns the Blackbird that mediated this interaction will be rewarded with tokens proportional to the number of bits that were sent by the IoT device.

The User who owns the IoT Device pays for the use of the Chirp Network by buying Chirp Tokens using fiat money, which once they are used transform into Data Credits. These are only partially reminted into Chirp Tokens when they are received by the Keeper, so the total supply of Chirp tokens in circulattion will always reduce in time.

## A spoofing-free network

A spoofed Blackbird, or a Blackbird that was hacked and tempered with, will be unable to pass through these validation tests, and will therefore not generate any tokens to its owner.

Stolen Blackbirds that can be validated will continue to generate tokens for the original Keeper. A thief cannot register the Blackbird to their own wallet or account, and the location of the Blackbird can be verified through GPS and LoRa at extreme accuracy.

# Chirp Tokens

Chirp tokens are the cryptocurrency used to consolidate value on the Chirp Network. It is used by Users of both the IoT and the ISP side to access the network and buy IoT coverage or wireless broadband connection, and it is also used to reward Keepers or Cardinal DAO investors.

## Chirp Token Creation

The Chirp token is created through mining by owning and correctly operating proprietary Chirp Hardware such as the IoT Blackbird or the Cardinal. The mining process involves providing wireless coverage to nearby Users who wish to access the network, and making it possible for them to transfer and exchange data between IoT devices and the internet, or connecting them to the internet at fiber speeds.

Chirp Tokens created from the Proof-of-Coverage process early on are newly minted tokens that first appear at the time when they are bought by the User who buys IoT Data Credits or a Wireless Broadband Subscription using Fiat Money through, for example, a Credit Card on-ramp.

Chirp Tokens that are received by the Keepers who facilitate the transfer of data through the Blackbird they own, or participants in the installation of a Cardinal through the DAO, are Tokens that are reminted from the burning of Data Credits, the fixed price utility token that translates between the variable price of the Chirp token and the amount of data that someone can transmit through the Network. Thus, increasing the usage of the Chirp Network does not inflate the amount of tokens in circulation, but rather burns existing tokens and deflates the total supply.

The Flywheel Model

Funnel and Pyramid Models often seen in Crypto economies suffer from a lot of volatility and instability, as seen in the extent of the crashes that occur during market downturns.

Chirp uses a different strategy, optimized for long-term operation and steady and safe growth for the decades of service proposed for the Chirp Network.

## The Virtuous Cycles

The Chirp Economic Model uses two distinct virtuous, positive loops, that reinforce the improvement of Mining Rewards across time, and the continuous expansion of the Network. These two cycles are based on the following mechanisms:

1. The token cycle
2. The Hardware Cycle

## The Token Cycle

The Token Cycle (1) is based on the fact that increasing usage of the network increases demand for the token, which results in more tokens being removed from the pool, which increases the price of the token, thus making the existing rewards more valuable in exchange for fiat.

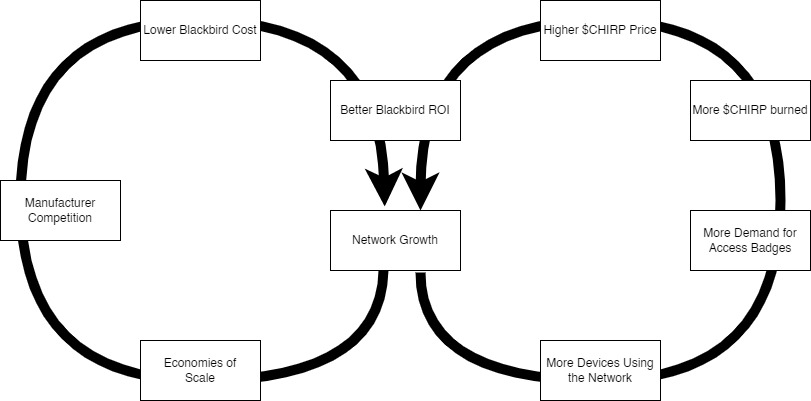
This Cycle makes both the token Transaction and Staking more attractive, as well as making the Mining of the Tokens and, consequently, providing coverage better for existing Keepers. This helps securing long-term rewards beyond just rewarding early adopters and covering the cost of the miner, also preventing short-sighted sale of token instead of holding.

## The Hardware Cycle

The Hardware Cycle (2) is based on economies of scale for the people who partake in the growth of the Network. More Hardware Manufacturers begin competing, making Blackbirds cheaper and increasing coverage and making Devices cheaper and more available, increasing network usage.

The Hardware Cycle makes usage of the network cheaper and more attractive because of the decrease in the cost and the increase of availability of devices, making it easier for the average person to quickly create an application of the Network that fits their unique needs.

By increasing Blackbird return on investment and by making Blackbirds cheaper as a result of competition between Manufacturers, it makes increases coverage easier by lowering the barrier to entry and improving the ability of Keepers to reinvest their rewards into installing new Blackbirds.



Token Price Stabilization Mechanism

Any person who has been involved in the crypto or financial markets long enough will surely have seen that every once in a while market events or changes in the economy can cause big movements in the apparent value of tokens and currencies on the market.

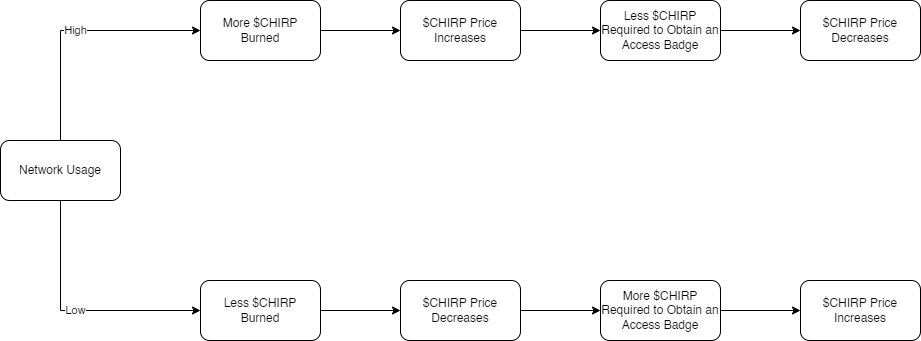
Chirp was designed in a manner that makes it easier to weather the storms of the market, because it is using a deflationary model that changes the number of tokens available, and the price of using the network, proportional to the real usage of the Network.

Because of this, long-term adoption is much more efficiently secured, since methods exist through which rewards are not based on temporary and short-sighted schemes, but instead decades of resilient growth. The distribution of tokens is spread across years to ensure that sustainable long-term growth can be assured, and nobody will be left behind from receiving lucrative rewards in the future.

The supply of tokens is permanently adjusted depending on how much it is in demand. The Burning Mechanism is a way for the Chirp token to literally transform the revenue of the actual Network Usage into Token Consumption.

When many people want to use the Network by installing new devices that communicate with Blackbirds and transfer a lot of data, lots of Chirp tokens get burned at the time of being transformed into access to the network. This makes the total supply smaller, meaning that the same or a greater network value is expressed by fewer tokens – growing the value of the Chirp token. To explore this in more detail, check out the \*\*[High Network Usage Scenario](/High-Network-Usage-Scenario.md)\*\*.

When fewer people use the network and growth slows down, fewer Chirp tokens are burned, which means that more will be circulating in the market, and the price for them will be smaller. Since access to the network and data transmitted on the Network always costs the same in dollar (fiat, USD) terms, the same amount of fiat will need to buy more tokens, which will increase the demand of the Chirp tokens on the market, making the price grow and compensate for the decreasing usage. To explore this in more detail, check out the \*\*[Low Network Usage Scenario](/Low-Network-Usage-Scenario.md)\*\*.



High Network Usage Scenario

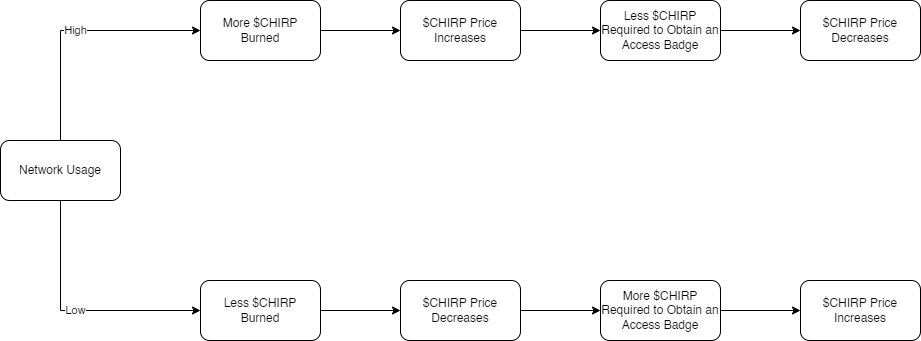
During accelerated Network Growth, when lots of people scramble to install as many Blackbirds as possible and the area of coverage where you can use the Chirp Network increases very fast, the number of CHIRP tokens being burned increases, which basically means that the total maximum number of Tokens on the Network decreases.

The decrease in total supply from burning causes the Price of the Chirp token to increase, because more value is represented by fewer tokens. This is normally called \*\*deflation\*\*, and it is the same mechanism that people tend to associate with “making money more valuable”.

Because the price of using the Network is expressed in Access Badges, which are of fixed value and pegged to USD, fewer Chirp tokens are required to use the network now that the value of the token increased. You can transfer more IoT data on the network with fewer Chirp coins. Because the dollar cost of IoT data stays the same.

If the cheaper cost of using the network does not create more usage of the network, which would be the case if lots of people install Blackbirds but nobody uses IoT Devices on the Network, the price of Chirp token can decrease, in order to prevent discounting the usage of the network until it does not reflect the real value of providing IoT coverage. The price decrease reverses the cycle, and assures that the total amount of tokens in circulation never falls too far in either extreme, but instead it can be used to reflect the real value of the Network.

Through these mechanisms, it is possible to assure that the value of IoT data is protected and rewards are always scaled according to the real market value of the service that the Chirp Network provides. Often, the push towards limitless growth using get-rich-quick-schemes result in sudden shortfalls once it is realized that in the absence of price stabilization, the access to the Network becomes too expensive or the rewards given to miners are unsustainable, undercutting decades of future growth and adoption for present, short-term, growth.



Low Network Usage Scenario

In order to not depend on the whim of the market, a mechanism to improve the performance of the token during low network usage periods exists. An example of such a scenario would be when not enough devices are available, or early in the lifetime of the Network, due to the time taken to scale up production and the time required for Gateways and Devices to ship and be installed.

Another scenario would be the exit of a major user, such as a commercial partner that uses the Network of an integral part of their operation, in which case this regulating mechanism prevents them having significant negative impact on the evolution of the Network.

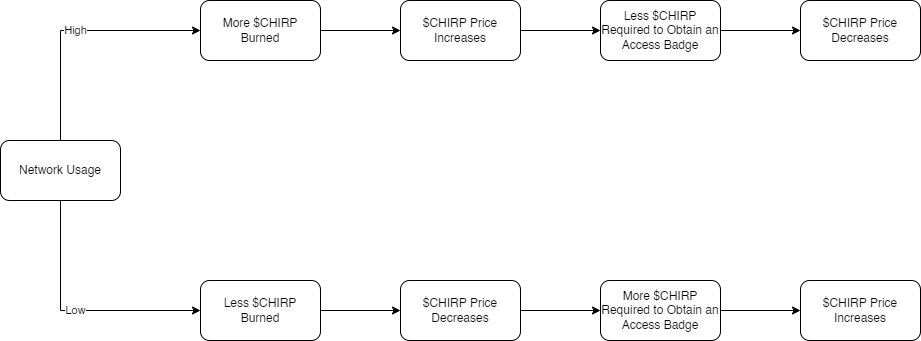
The decreased usage of the Network results in a much lower amount of burnt tokens, therefore the total quantity of tokens on the market and in circulation increases significantly. The lower number of tokens burned and the steady release of tokens through mining causes, if significant quantities of tokens are sold, in a temporary price decrease for the Chirp token.

The decrease in the price of Chirp results in a higher quantity of Chirp tokens to be required for buying the same amount of IoT data on the Network, because this is represented by Access Badges which are fixed price in relation to the fiat dollar (USD). Buying 100kb of IoT traffic on the Chirp Network will cost more Chirp tokens that previously, which will increase the demand of the Chirp token on the market, absorbing the excess of tokens on sale.

By increasing the number of tokens that get bought from the market proportional to the amount sold, the price of Chirp will start to increase, causing stabilization of the price of the Token.

This mechanism protects the value of IoT traffic on the network, and improves the stability of long-term rewards for both early and late adopters of the technology.

The Chirp Token is better protected from market volatility and instability, making it better capable to weather the storms in the crypto-space and wider economy, with better correlation to the actual cost of the service provided, IoT coverage, which makes it not dependent from speculation in the manner seen in other cryptocurrencies.



LoRa vs LoRaWAN

## LoRa Reminder

LoRa is the IoT communication protocol optimized for very long range transmission of small quantities of data. It can provide IoT applications using specific devices that connect to a central point, called the Gateway, that interprets the chirp signals into digital information and sends it through the internet.

## What is LoRaWAN?

LoRaWAN is the type of Wide Area Network (WAN) created specifically for LoRa, which enables the standard of a low power and long-range (LPWAN) network based on Semtech’s LoRa Devices, using unlicensed (open, free) sub-GHz and Industrial, Scientific and Medical (ISM) radio bands.

## What makes LoRa Work? (Semtech and the LoRa Alliance)

Whilst Semtech proides novel LoRa Chipsets, semiconductor devices that enable the functionality of LoRa Gateways, the LoRa Alliance is the international non-profit organization that groups together the most important companies engaged in the development of a globally standardized and harmonious set of standards for LoRaWAN.

## Isn’t it the same?

In short, no. LoRa is the communication protocol, the technology that makes it possible to do long-range wide area IoT with extremely low power consumption. A single LoRa Gateway can be installed in a home to enable the use of LoRa for a few local devices, but this does not constitute a LoRaWAN Network.

Creating an IoT Network is possible using various types of communication protocols. The Blackbird, for example, provides two standards of LoRa (sub-GHz and ISM 2.4GHz), Zigbee and BLE. The Chirp Network constitutes a LoRaWAN network because it uses LoRa and follows all of the standards and regulations imposed by the LoRa Alliance.

## Why is this distinction important?

Creating a Network requires the installation of a lot of Gateways and Devices in a single network that follows the requirements and specifications imposed by the LoRaWAN standards. They are dictated by the LoRa Alliance, in order to be legally recognized and approved by both the International Telecommunication Union (ITU) and various local/national regulators. Because of this, anywhere you go you can be sure that the Devices/Gateways and the LoRaWAN Networks will function well and all devices that use Semtech Chipsets or are certified for LoRa will be the compatible with the Network.

Semtech Chipsets

## Who is Semtech?

Semtech is the provider of multiple new and innovative semiconductor devices required in the creation of advanced LoRa products. They are one of the most important actors in the adoption of LoRa as a leading IoT communication protocol in commercial applications for the expansion of IoT.

Chirp makes use of novel innovative chipsets created by LoRa to implement the cutting-edge version of LoRa made available in recent years, enhancing the functionality of the network from the start with respect to improving compatibility, reach, data rate, eliminating regional barriers, improving location accuracy, and many others.

## Semtech SX1280

[SX1280 | Long range, low power 2.4GHz RF Transceiver | Semtech](https://www.semtech.com/products/wireless-rf/lora-connect/sx1280)

The Semtech SX 1280 chipset is the essential addition to the Blackbird that enables ultra long range communication with great resistance to heavy interference and global compatibility with all LoRa devices on the market because of the introduction of \*\*2.4 GHz LoRa\*\*. Check out Chirp’s Wiki entry on \*\*[Wi-Fi and BLE immunity]()\*\* and Semtech’s articles ([Salesforce](https://semtech.my.salesforce.com/sfc/p/#E0000000JelG/a/2R000000HSNz/HeroVQVfOkV2KaLGS7BiPaFWWoCXVsrP3rFKf9hs6JQ) BLE, [Salesforce](https://semtech.my.salesforce.com/sfc/p/#E0000000JelG/a/44000000MDcO/Ll4bon.4HPwcyXv9fegcfcgbpvLYd7Lx_aZLMzYNLIQ) Wi-fi).

## Semtech SX1303

The SX1303 is the newest generation of LoRa chipsets, which result in extremely good \*\*[geo-location detection]()\*\* because of the introduction of Fine Timestamp capability. This means that the Gateway (in our case the Blackbird) has a much better internal clock that can be used in the algorithm used to interpret the time taken for a LoRa signal to reach to and from a LoRa device and several Gateways into their precise position in space. In addition, the SX1303 also provides lowered power consumption and a smaller overall size.

NOTE: With the SX 1303 a device does not need any sort of GPS or location indicator! Anything, including a simle temperature sensor or a smart plug can be located just from the time it takes to respond to a chirp signal sent by our Blackbird.

## Why should I care?

Because LoRa chipsets are at the very core of the Gateways, upgrading them in older devices requires a complete recall of all of the LoRa Gateways for the replacement of the chipset in order to make the new functionalities available. Firmware upgrades are limited in older devices and, thus, it is a very important unique benefit of Chirp compared to older legacy Networks to be able to roll-out the most novel solution from the start.

Tips and Tricks to maximize Rewards

## Blackbird Location

A single Blackbird can provide long-range coverage for dual-band LoRa of up to hundreds of kilometers. Installing them close together is often times inefficient and in certain cases it may not produce any additional benefit whatsoever.

Because of this, optimizing the placement of your Blackbird Gateway is one of the most important things to consider when becoming a Keeper.

* Installing two Blackbirds close together or next to another existing Blackbird, at a distance of less than 400m, will generate no rewards whatsoever.
* Once more than X Blackbirds are installed in the same 1 square mile area, the area is declared saturated and it will be impossible to add more Blackbirds in the future.

## Blackbird Height

* Providing good signal coverage is best when the Antenna is in direct line-of-sight to other Blackbirds and Devices. In order to achieve this, you must make sure that your Blackbird is not obstructed by buildings, mountains or any other thing that may decrease its visibility.
* It is a best practice to install the Antenna as high-up as possible, on top of very tall buildings, on radio towers, on top of hills, etc.

## Maximize Availability

The Blackbird requires, at minimum, only two things to function:

1. Power
2. Internet access

These can be provided in various configurations: either using a single Ethernet cable that provides both, a single power cable and a Wi-Fi connection, or using batteries and solar panels and LTE or Sattelite backhauls for installation in remote locations.

* Make sure that any set-up you create functions properly all of the time, because you will not be rewarded during the time when the Blackbird is not connected to the internet or is not powered.
* Make sure to attach and protect the free part of the cable somewhere to prevent debris, hail, birds or rodents from breaking it

## Check Connector Health

* Check the quality of connectors (ethernet, power) and cables in order to prevent accidental disconnects or loss-of-power
* Make sure to connect the antenna with the Blackbird with a cable at least 150cm (60’’) in length to eliminate any cable induced interference or impedance. (12 times the 2.4 GHz wavelength)
* Make sure to avoid coiling up long cables, especially those transporting low currents and signals, because this creates additional impedance when the cable acts as a inductor. Keep cables as straight as possible.

Blackbird Upgrades

Technology is advancing incredibly fast. In a frontier technological field such as the Internet-of- Things, a few years could result in fundamental changes to the usability and function of a device. In order for the long-term ambition of Chirp to be possible, the mistakes of projects that came before must not be repeated, and thus, upgrading the Blackbird was assured from the very start.

## Easy, Modular and Future-proof

Due to the existence of multiple independent IoT technologies, a decision was made early about the architecture of the Blackbird. Wherever possible, the chipsets and internal components were made as modular as possible in order to assure that non-experts and nontechnical people.

## Hardware Upgrades

Modularity means that individual section of the internal components of the Blackbird can be simply removed with no specialized tools, just a screwdriver and patience. Replacing them is as simple as cleaning up a laptop or replacing a hard-drive.

For Zigbee Modules and newly added IoT Protocols expected in the future, considering that these are from the start defined as optional and are installed using plug-and-play USB dongles, upgrades would be as easy as simply replacing a USB stick.

## Software

Software updates are expected to happen on-the-fly periodically. This does not require any particular action by the User. When turned off due to cost of data over LTE and Satellite, doing the upgrades on site by manually connecting to your Blackbird is also possible.

## Financing

For 30 years of usage, replacement of the main IoT technologies can be scheduled periodically, for example once every 3 years. By purchasing the modules through Chirp you are guaranteed compatibility with the Network and Devices, and you will receive additional discounts or improved rewards through mining on the Chirp Network.

One example scenario is that of the Austrian Backpack – a part of the mining rewards that would’ve otherwise been burned can be blocked in a savings account, and these can be sold to Chirp for discounts or to cover the purchase of components for upgrading your Blackbird, which will improve the properties, usability and rewards associated with your Blackbird Miner.

Chirp’s Miners

## Designs

Chirp designs and collaborates with existing suppliers and manufacturers to create its own line of primary and secondary hardware, in order to supercharge the potential of our Network and to permit the use of the most novel technologies currently available on the market and in order to future-proof our technological position in a way never before achieved by decentralized IoT providers.

Our team provided the conceptual design and architecture definition for the Blackbird, the first of Chirp’s released pieces of proprietary hardware.

## Blackbird

The Blackbird is the flagship IoT Gateway, capable to provide IoT connectivity for multiple different IoT communication protocols such as dual-band LoRa, BLE and Zigbee. The Blackbird is also the main Miner for the IoT side of the Chirp Network, as it provides token rewards for IoT data traffic on the Chirp Network and for providing signal coverage.

## Satellite & LTE Backhaul

To make it possible to provide coverage in remote areas where it may not always be possible to use Wi-Fi or an ethernet connection, both Satellite and LTE (cellular/3G) backhauls can be used to replace the internet connection. This enables Blackbird installation away from your home or on radio tower that do not offer internet as one of the facilities on offer.

## Cardinal

The Cardinal is the main expansion of the Chirp Network, that enables the provision of high-speed wireless Fiber Internet at speeds above 1Gbps in a decentralized fashion by assuring ownership through a DAO where individual people who invest are rewarded from the pool of revenue coming from Broadband Subscriptions. The Cardinal is modular, and has one Beaming unit that takes internet at a point-of-presence from a main optic fiber connection, beams it up the Emitter Cardinal, that connects to up to X individual receiver antennas installed by end-users who are subscribed to the Chirp Network Broadband.

## The Vulture

The Vulture is the second DAO created on the Chirp Network, and it is a satellite launched by Chirp and its partners to provide IoT coverage in a fashion similar to the Blackbird, but with immense area of coverage, across the planet, with almost perfect line of sight most of the time.

Similar to the Cardinal, the Vulture is financed and governed using the DAO methodology, which means that ownership will be shared by a number of investors who will gain proportional rewards to the ownership share resulted from the sum invested in its creation.

## Token Economy Implications

Each one of the miner Devices (Cardinal, Blackbird, Vulture) generate rewards based on the same tokenomics model presented in other wiki entries and on the main Tokenomics Document. They all provide rewards in the same token, the Chirp Token.

Chirp’s Non-Miner devices

## IoT Devices

An IoT Device is a small and very low power device that can transmit and receive small quantities of information through the form of data packets, necessary in different IoT applications, to a Blackbird, Chirp’s IoT Gateway. The lifetime of the average battery powered device is usually on the order of months or years, with some LoRa class A devices lasting up to 3 years. Devices are each made for a specific communication protocol, such as LoRa, BLE or Zigbee, and are not often capable to use more than a single communication protocol.

To learn more about example devices for each communication protocol, check out their particular wiki entries:

* LoRa devices
* BLE devices
* Zigbee devices

## Chirp’s Proprietary Devices

Chirp is working together with existing device manufacturer to produce and launch our unique line of bespoke devices, which can provide the best performance to take better use of the enhanced potential of the Blackbird compared to older, Legacy and Existing Networks.

## Chirp’s Mockingbird

The Mockingbird is a Router Repeater – a device developed to not provide the same functionality as the main Blackbird or Cardinal, but which is capable to extend the range of the signal provided by the initial device in order to both increase the total range of the network coverage provided, but also to allow the signal to pass around large obstructions that could otherwise impede signal propagation in space – such as going around a large building or the top of a hill.

The Mockingbird is available for both the Cardinal (Fiber Broadband) and the Blackbird (IoT) side of Chirp’s Network

## Token Economy Implications

Non-miner devices such as the IoT devices and the End-User Receiver Antenna usually require payments done through a credit card or through Chirp tokens to provide communication.

All Miners and Devices appear on the Dashboard, the website and mobile app that Chirp Network users can use to see at a glance all of their activity and applications on the Chirp Network.

Cardinal DAO

## Governance and the DAO

The Cardinal project will have a decentralized governance system with a built-in voting mechanism. This will allow token holders to vote on important issues regarding the operation of their local ISP antenna. It will also use an internal governance system where users can vote on how they want their tokens to be used or transferred. Crypto governance is the process of making decisions on how to move forward with Cardinal's development. This includes voting and consensus-building processes that help determine which features get implemented and how they are implemented.

## The selling point:

The Cardinal DAO is already significantly above the average speeds in developed nations, and comparing roll-out costs and subscriptions prices, it likely will remain so for many years to come. Regardless, the very low price and relatively large modularity of the antennas permits breaking down a large community project into small parts, making it easy to make upgrades in the future. Essentially, a single antenna provides internet to a predefined number of people, however when more antennas are needed, more antennas can be installed, each one potentially easier to install than the last.

Cardinal Antennas

In order to become an Internet Service Provider (ISP), an optical fibre connection found in the general proximity (e.g. Cogent, Arelion, Liberty Global) is used to beam data from to the main Cardinal Antenna Emitter on top of a well-placed radio tower using the 60GHz frequency band. The maximum distance for this connection is estimated at around 8 km.

Cardinal Emitters must be installed in a very good location within line-of-sight to their clients or target community. Clients can receive extremely high speed, up to and above Giga-byte speed, by connecting with a Receiver antenna placed outside of their home or apartment, which can act as a nearby Wireless Router from which it is possible to connect over wi-fi or ethernet cables.

The connection between the Cardinal and the end-user is managed over the 16 GHz band, except when the weather is very poor or obstructions are in the way, decreasing range. In this case, a 5GHz back-up link can be achieved, the same frequency used in the newest and highest speed Wi-Fi routers.

Multiple Cardinal Antennas can be installed on the same tower to increase the number of people that can be serviced in the general area. Normally, there is a maximum number of people that can connect to a single Cardinal Antenna Device, and the area of coverage is limited to a roughly 120 degree cone in front of the Emitter Antenna.

Three Cardinal Antennas can provide bandwidth of up to 16.2 Gbps, divided, at most, to 45 end-users. The maximum possible bandwidth that a single Client can take is 5.4Gbps. The Receiver Antenna itself uses the 5 GHz frequency band to transmit the internet, similar to a modern WiFi router.

An installation of multiple Cardinals on the same tower is called a Cardinal Nest or Hub. Nearby Cardinal Hubs can create a Mesh network that allows them to transfer information or connect to each other. The Mesh Network makes it possible for other Cardinal Antennas to cover the loss or breakdown of a different Cardinal, making sure that the end user never feels the loss of connection, but is instead able to continue browser the internet normally, with no knowledge of a problem.

Service Level Agreement

## What is it?

The Service Level Agreement (SLA) is an important condition in order to provide the same or better quality internet as any existing Internet Provider, and fulfilling every condition to be qualified as a fully functional and legal decentralized internet service provider.

## What is the relation with Chirp’s Mesh?

Chirp is able to provide the SLA using a Mesh network, where every Cardinal Antenna in range is in permanent communication with every other. Because of this, the other Cardinal can take over the functions of the one that is broken or turned off.

Our Mesh technology includes both the broadband Cardinal and is tested beforehand on the IoT side, using the Blackbird. A Mesh network makes the rerouting of internet signal possible, because it acts almost immediately to keep alive the connection between the Internet and the Client.

## Why is this important?

The Service-level Agreement (SLA) makes Chirp is the first decentralized broadband provider capable to provide a decentralized solution.

The Client is not impacted by failures of the Antennas and Devices, weather and obstructions, power outages on the power source for the Cardinal, and many others. Furthermore, dividing internet demand to nearby Cardinal antennas makes it possible to improve the profitability of the network.

A client who wishes to use the Cardinal to access very high speed fibre internet over air, without cables, requires ownership of a Receiver Antenna and an internet subscription paid through credit or debit card as a fiat on-ramp used to buy Chirp Tokens.

The cost of the Cardinal itself is divided between all of the participants in the DAO, who are also entitled to the ownership of the Cardinal and proportional profits from its operation. These participants in the DAO and later Governance depend on the good function and the attractiveness of the Service offered by the Cardinal, and thus most definitely need the SLA as a guarantee of technical soundness and market readiness for the technology, so that their investment can be returned and profits generated.

Mockingbird

Vulture

R2

R2

R1

R2

R1

Transmission

Transmission

Extend to transmission

Extended until the next Transmission