



Emerald Circuit Cryptonomics

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Section 1: The Emerald Circuit sidechain & the Emerald Token

Emerald Circuit is a sidechain protocol integrated with the Ambrosus Network (AMB-NET). As a sidechain, Emerald Circuit receives and transmits data according to its own proof of authority consensus mechanism, as well as through its own native token. The hash of each sidechain transaction is integrated into the Ambrosus network, and ultimately hashed onto the Ambrosus blockchain - AMB-NET. The benefits of managing data on a separate sidechain are that: 1) The Ambrosus Network is not overloaded with transactions, 2) transactions can be localized on the Emerald Circuit sidechain for regulatory and data protection purposes, and 3) the unique advantages of the Emerald Circuit cryptonomic model (i.e. commission fee) can be imbued through the Emerald token and disbursed to Emerald Circuit node operators for the services they provide to the sidechain network.

1.1 The Emerald Token (EMR)

The Emerald Token is a fixed stable coin pegged to the US Dollar on the Emerald Circuit side chain. Such a token is directly tied to the data sent from proprietary IoT Devices also referred to as 'intelligent objects'. The logic behind the cryptonomic design of the Emerald Token is straightforward: Enterprises require stability in purchasing and managing software and data. Node operators are rewarded for validating transactions of this data. As more transactions are sent across the network, more transaction fees are dispersed to the relevant node operators increasing the incentive to operate a node on the network.

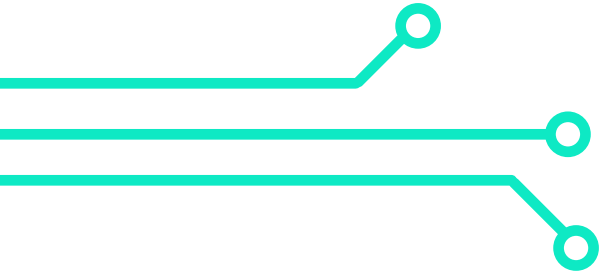
Through such a design, enterprises are able to seamlessly pay (on a subscription basis) for software and blockchain services in a manner that can be directly translated into a token-based model for securing distributed network data. In a similar fashion,

third party consultants or other entrepreneurs wishing to integrate Emerald Circuit IoT devices with their own solutions can easily do so without price fluctuations or exchange difficulties.

The Emerald Circuit Token

Type of Token	Utility Token
Token Name	Emerald Token (EMR)
Total Supply	14,000,000 EMR
Subunit of Token	Embers

Additionally, a built in ‘commission’ fee for the sale of the physical hardware devices, is also factored into the transaction fee rewards for Emerald node operators (See section 5 *Commission Fee*).



Section 2: Data Flows and Cryptonomic Dynamics

In every public blockchain ecosystem, an accompanying cryptonomic design must balance three primary considerations: speed, security, and scalability - also known as the blockchain trilemma. For the Emerald Circuit Sidechain in particular, these three considerations must be adequately applied to the management and security of IoT device data as it is collected and hashed onto the chain.

Scalability

Emerald Circuit is able to address the challenge of scalability through utilizing Hermes Masternodes to bundle and hash asset and event sensor data, at a rate of 16,384 readings per bundle. With all data eventually being hashed onto the main Ambrosus blockchain - after first passing through the Emerald Circuit Sidechain - the model is capable of scaling to the point of managing hundreds of thousands of sensor readings per second.

Speed

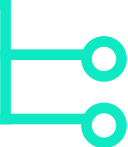
Sensor data is frequently collected at intervals measured in seconds or minutes. As such any sidechain or blockchain will need to guarantee that data can be stored quickly and efficiently without delays or long transaction periods. To do this, Emerald Circuit is able to quickly achieve consensus on the side chain, among a number of node operators according to a proof of authority consensus mechanism in which validators are selected based upon their commitment to the security of the network and the stake they are willing to lock into the network.

Security

A secure sidechain must process transactions from a distributed network of (self-interested) validators. Using game-theory dynamics the security of a sidechain must be designed in a manner such that network validators are not incentivized to corrupt

or falsely validate transactions. As a result, sidechain security is closely connected to the cryptonomic design and incentive structure built into the network. Emerald Circuit's sidechain security is achieved through rewarding validators according to their uptime on the network, and their stake in the sidechain system.

Emerald Circuit's cryptonomic model is built upon a Proof of Authority consensus algorithm, designed to securely and scalably manage data flows from endpoint IoT devices. In essence, the system is controlled by two key parameters:

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- The Flow of Data Onto the Network.
 - Cryptonomic Incentives for Validators to Maintain Consensus on the Network.

Data flows refer to the collection of data onto the Emerald Circuit sidechain from intelligent objects. Specifically, device data is the 'lifeline' or 'blood' of the sidechain as users and stakeholders will utilize the 'Emerald' token (EMR) to digitally value and manage their data. As more devices collect and transmit real-time information onto the sidechain, the more activity, incentive, and value is created on the sidechain network.

Cryptonomic incentives for network validators refer to the token-rewards generated from maintaining the state of the network. The incentive structure built around the Emerald token, is discussed in further detail in Section 4 - *Emerald Token Cryptonomics*. The proposed system is a middle-ground solution for accommodating enterprise needs, long-term growth of the ecosystem, as well as network security.

Section 3: Proof of Authority Consensus

The Emerald Circuit sidechain mirrors the Ambrosus blockchain in operating according to a Proof of Authority consensus mechanism. A single tier of authority nodes are utilized to secure the Emerald Circuit Sidechain:

Jade Validators	Requiring a stake of 2,000 EMRs or more
Silicon Validators	Requiring a stake of 10,000 EMRs or more

Following Ethereum's [Aura-Authority Round Consensus Algorithm](#), finality is established among consenting operators based upon a simple majority vote. Malicious node operators can therefore not finalize a block unless they are able to operate in unison, more than a majority of nodes on the network. Using a *Forced-Sealing* command, blocks are produced as soon as the network is launched regardless of transaction load. This ensures that blocks reach finality in a timely fashion.

Silicon and Jade validators lock up Emerald Tokens (EMRs) on the Emerald Circuit sidechain as a placement of stake in the longevity of the network. When achieving finality, node operators validate transactions and maintain the state of the network, from which they are entitled to receive a *CoinBase Reward* in proportion to their stake.

As a public permissionless sidechain, Emerald Circuit is therefore structured similar to the Ambrosus Blockchain. Consensus is achieved from a set of authoritative actors who have a vested interest in the maintenance of the network. Malicious behavior is curtailed and malicious nodes are penalized through the loss of their stake on the network. Finality is achieved in a round-robin fashion with each operator validating the next block on the chain.

Section 4: Emerald Token Cryptonomics

The cryptonomic design built around the Emerald token must consider three primary factors:

1. The security and efficiency of the network.
2. The commercial incentives for utilizing the network.
3. The validator incentives for securing the network

To create a robust sidechain infrastructure that will someday manage millions of IoT Device readings every hour, Emerald Circuit's cryptonomic model - built around the Emerald Token (EMR) - is grounded in the following design:

Coinbase Reward

Following the design of other blockchain ecosystems, Emerald Circuit's cryptonomic design ensures consistency of gas fees for commercial usage purposes, while also incentivizing validators to maintain state security. Of the initial circulating supply, the network protocol will issue 10% new tokens of the existing circulating supply on an annual basis, of which 90% will be diffused to network validators for securing the network in proportion to their stake in the network. 10% is then maintained as a protocol treasury for the growth of the Emerald Circuit sidechain development.

Utility Token for Anti-Counterfeiting Services

For commercial purposes, the Emerald Circuit sidechain utility token - known as the *Emerald token (EMR)* - will be issued at a price of \$1.00 USD per token as a utility token used to designate anti-counterfeiting data security on the Emerald Circuit sidechain. For commercial SMEs (Small and Medium Sized Businesses) anti-counterfeiting data

managed on the Emerald Circuit sidechain will be offered according to a Software as a Service model (SaaS) in which enterprises pay a fixed price of USD in EMR for the tracking of their devices security. This service will be offered alongside blockchain as a service (BaaS) costs paid in Amber.

Intelligent Object Licensing

The licensing model for intelligent objects is built around sending data to the Emerald Circuit sidechain and ultimately the Ambrosus blockchain. While the objects are first bought for a fixed price in US Dollars paid in EMR, a software license of five dollars per intelligent object (calculated as a single total per order) is charged on a monthly basis. Payment of such a license is directly pushed into EMR tokens on the Emerald Circuit sidechain. A sensor operating area, similar to the Ambrosus masternode operating area, will be built in order to allow network validators to visualize the current state of usage and different types of sensors on the network.

Protocol Treasury of 20% per annum to bolster Ecosystem Growth and Development

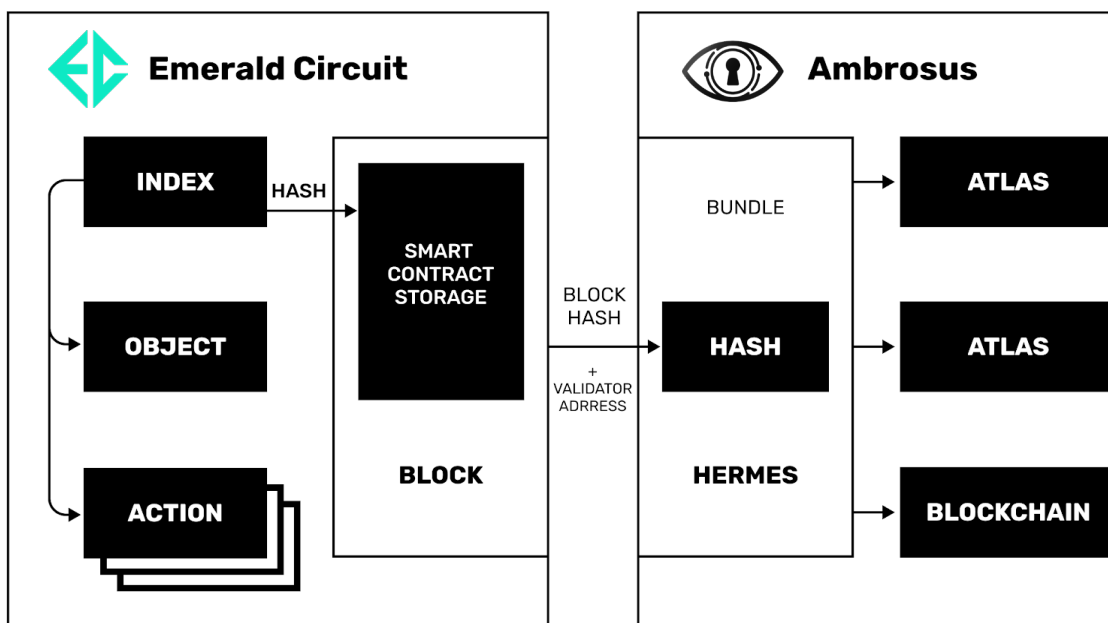
Last but not least, the Emerald Circuit Foundation has created a protocol treasury of 25% of the annual Coinbase reward tokens. These tokens will be allocated for the development of the Emerald Circuit ecosystem: for community bounties and growth opportunities, for entrepreneurs building specific industry verticals leveraging an Emerald Circuit intelligent object, for pitches and presentations, and for dApp development that facilitates ease of access for commercial enterprises.



Section 5: Integration with AMB-NET

To ensure the security of the Emerald Circuit network, the hash of each block along with the address of the validator that created it, is added to the bundle of a special Hermes node in the AMB-NET. A separate validator on the side of the Hermes node validates that the hashes match the real hashes in the Emerald Circuit blockchain. The AMB-NET ensures safety of this data due to the distributed and reliable storage of bundles on Atlas nodes. In case of the bundle loss on the Hermes node, it can be restored from the copy stored on the Atlas node.

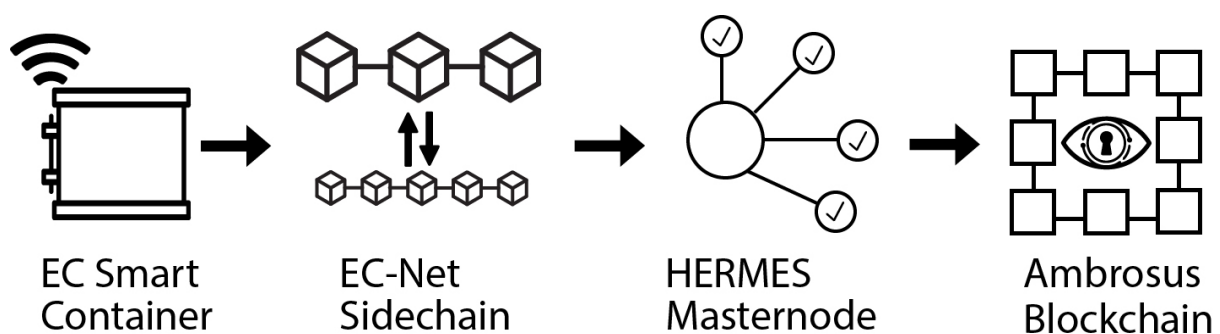
DATA FLOW



Sidechain to blockchain data flows

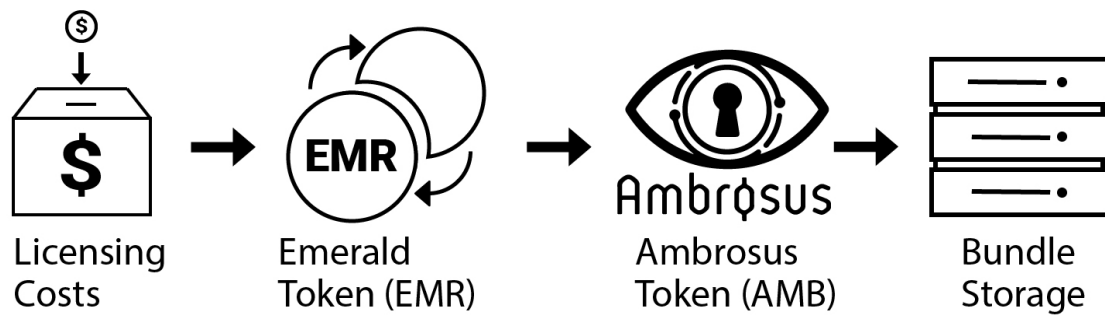
5.1: Data flows from sensor to blockchain

Data flows from the end-point of an intelligent object are either networked through a physical gateway before being directly sent to the Emerald Circuit sidechain, or simply sent straight from sensor to sidechain. Depending on enterprise preferences, this data can be sent to a custom ERP or private database in unison with its transmission to the Emerald Circuit sidechain. Upon arrival on the sidechain, data is validated and a hash is recorded by Emerald Circuit node operators. The data of the IoT devices is then sent on to the Ambrosus network from which a bundle of the data is stored by Ambrosus masternode operators.



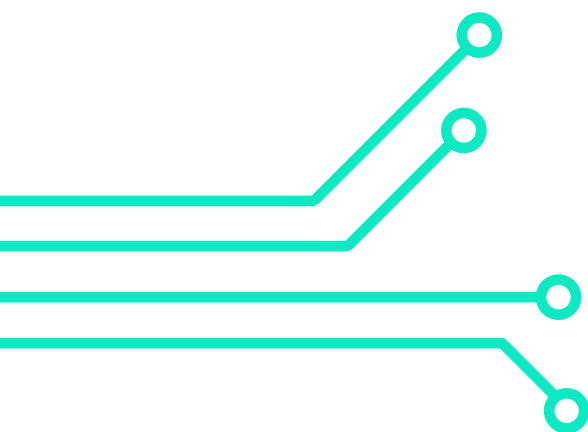
Data flow from sensor to blockchain

The transfer of value for the security of the data mirrors the flow of the data through the sidechain and onto the Ambrosus blockchain: Using a licensing model, enterprises pay for their data security and storage directly to the Emerald Circuit sidechain. As EMR is a fixed stable coin, enterprises are guaranteed a direct exchange rate without worry of volatility. Upon payment, data is hashed onto the Emerald Circuit sidechain: 85% of transaction fees on the sidechain are then burned, with the remaining 15% being sent with the data to the Ambrosus Network for data storage purposes.



Cryptonomic data flows from license to storage

As a utility token, EMR is used to pay for data authentication and IoT storage on the Emerald Circuit sidechain, and for ultimately covering transaction and storage costs on the main Ambrosus blockchain. In operating as a sidechain, IoT device data can still be authenticated without clogging the Ambrosus network over time, while data storage and its accompanying benefits can still be sent to the Ambrosus blockchain and stored by Ambrosus node operators. Both the larger Ambrosus ecosystem, and the Emerald Circuit sidechain can therefore grow in a mutually beneficial fashion.



Section 6: IEO Tokensale Details

The Emerald Circuit IEO will run in Quarter 1 of 2021. A total of 7,000,000 (seven million) EMR's will be issued for the public offering. During the first round offering the first two million EMRs will be offered for a 20% discount for \$0.80 cents on the dollar. The remaining five million EMRs will be offered at a 10% discount from its price point of \$1.00 USD. The total hardcap of the Initial Exchange Offering will cap out at 7,000,000 EMRs in the token sale.

Token Name	Emerald Token (EMR)
Token Price	\$1.00
Round 1 Sale	2 million EMRs at 20% discount = \$1,600,000 Soft Cap
Round 2 Sale	5 million EMRs at 10% discount = \$4,500,000 Main Sale
Hard Cap	7 million EMR for total valuation of \$6,100,000 USD Hard Cap

Management of IEO Funds

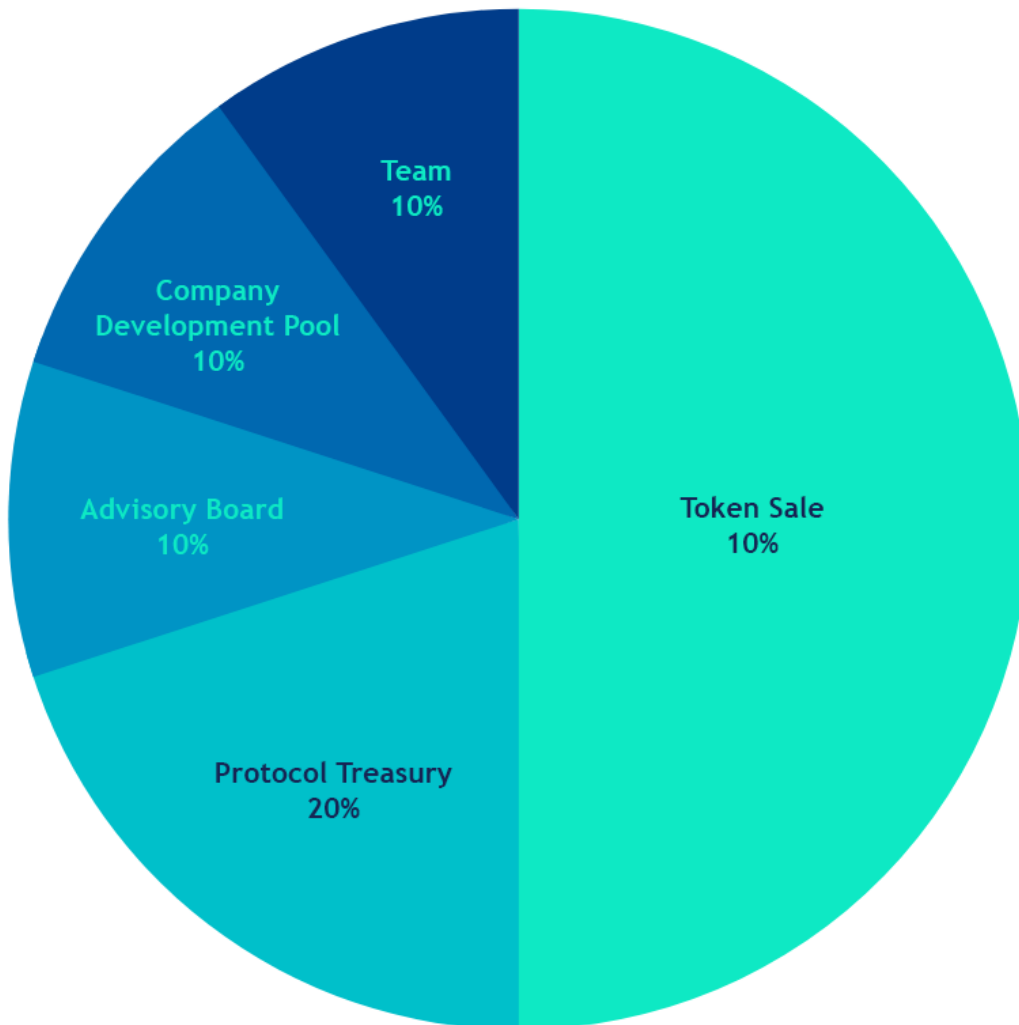
The funds raising in the Emerald Circuit Initial Exchange Offering will be used by the Emerald Circuit Team to launch the full-scale production of its proprietary IoT devices; to fully develop the sidechain functionality; to establish business development and marketing strategies for selling Emerald Circuit devices across the globe; and for team member compensation and community development initiatives.

Total EMR Emission Distribution: 14,000,000 EMR Issued

Token Sale: 50% (7,000,000 EMR)

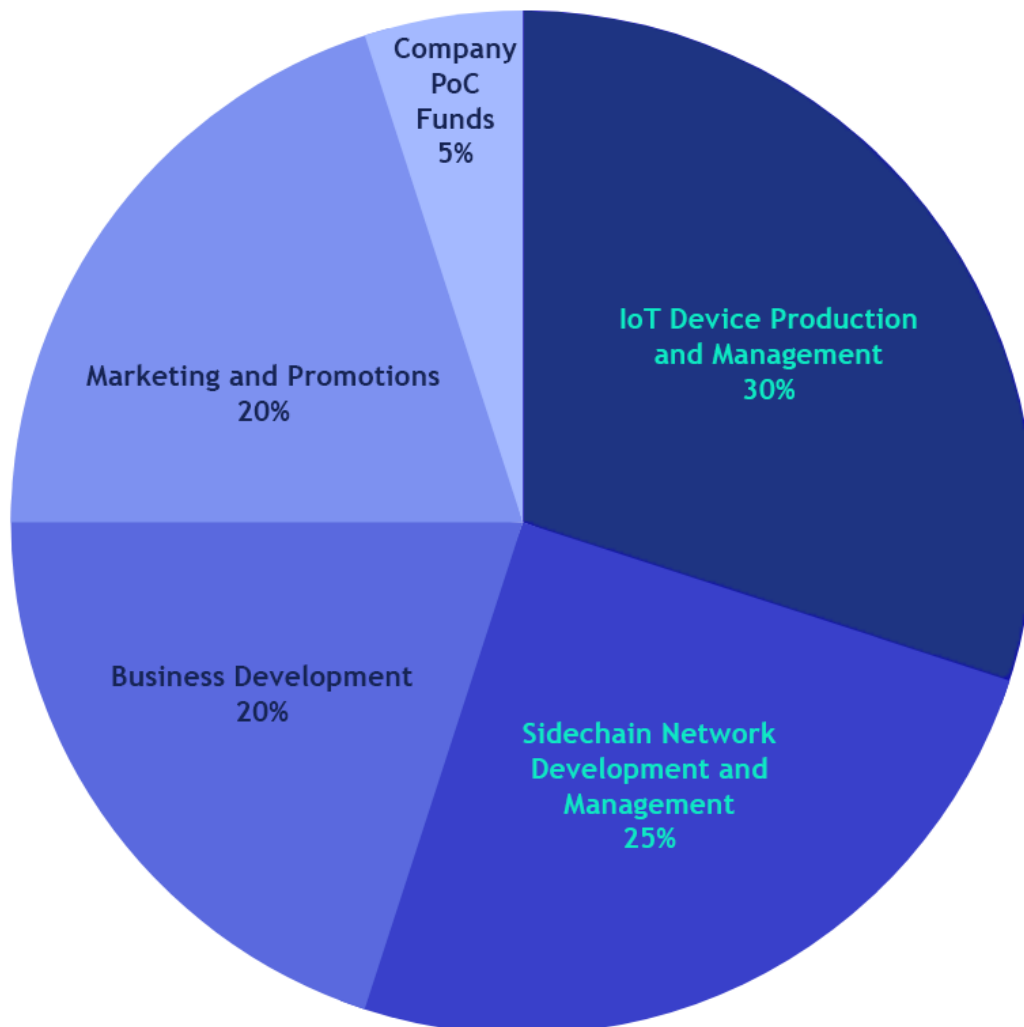
Company: 50% (7,000,000 EMR)

- Protocol Treasury 20%
- Advisory Board 10%
- Community Development Pool 10%
- Team 10%



Operational Funds: Collected in BTC / ETH / AMB from Token Sale

- IoT Device Production and Development: 30%
- Sidechain Network Development and Management: 25%
- Business Development: 20%
- Marketing and Promotion: 20%
- Company PoC Fund: 5%



Further details of the roadmap after the IEO are discussed in the *Emerald Circuit Whitepaper*.