# DeMR Network White Paper

## 1 Introduction

### 1.1 DeMR Brief

DeMR is a decentralized Mixed Reality (MR) infrastructure network (MR-DePIN) built on the Solana Chain. Global users may participate in scanning and building MR maps of various cities with consumer-grade devices, and build infrastructure facilities through decentralized distributed concurrent architecture to provide a Web3 infrastructure that serves massive MR applications and global users, realizing complete interconnection and decentralization between MR application ecology and virtual-real symbiosis scenes based on DeMR, MR & AI spatial computing technology. The digital world created by MR & AI spatial computing technology can coexist with the real world seamlessly, allowing people to get access to the delightful new world of spatial interconnection and virtual-real symbiosis anytime and anywhere.

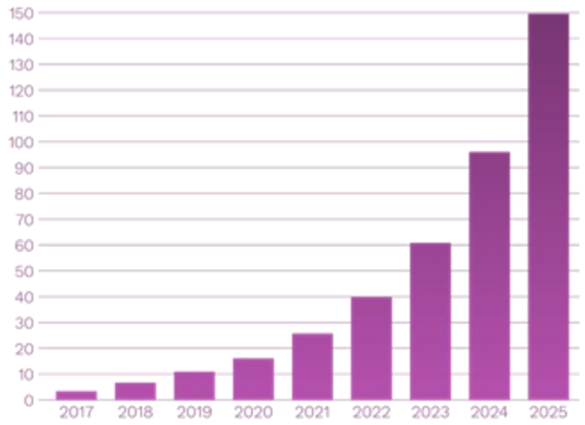
In DeMR Network, each Contributor, Land Holder and Developer is connected through the blockchain network, and the Contributor could earn revenue by contributing to the network construction through scanning and annotating (Scan to Earn). The network gives incentives to each Contributor through the cryptocurrency DMR (DeMR Network Token), and the Developer invokes services such as MR map positioning and spatial computing to builds his own MR spatial Internet DAPP by paying DMR, ultimately forming a huge global decentralized MR metaverse infrastructure with the most advanced spatial computation technology, and the massive ecological applications and spatial traffic interconnection can be built on it.

DeMR's global decentralized MR high-definition map serves as the infrastructure of Web3. It supports massive DApp data interoperability, mutual invocation, and interaction among users. Additionally, it facilitates cross-chain functionality within the protocol, creating a base layer in the spatial Internet era. This forms a mutually beneficial symbiotic relationship with blockchain L1, L2, exchanges, and DApps such as DeFi, SocialFi, GameFi, and other projects. In the future, DeMR will also launch more relevant organizational operations and ecological incentive mechanisms through city and application DAOs.

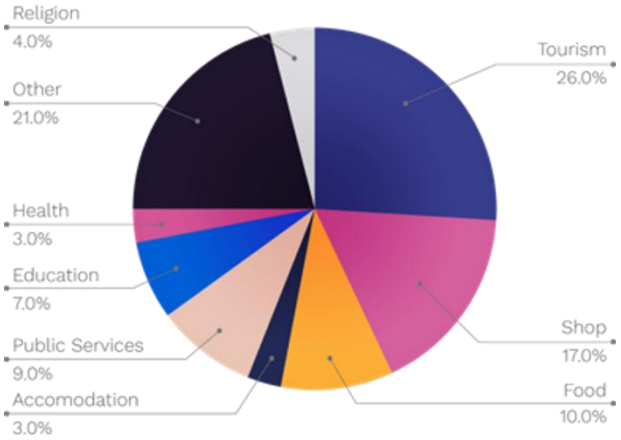
## 1.2 Market Overview

Billions of people around the world rely on map services. Maps are used by life services, logistics companies, navigation, real estate services, insurance companies, social and other mobile applications, governments and so on, and have become an important part of the world's technological infrastructure, with a market size of hundreds of billions of dollars. Nowadays, map services have fully entered the era of 3D spatial maps, 3D maps will be the interconnected infrastructure of spatial information for the next 30 years.

As the MR industry gradually matures, MR is entering a period of explosive growth and is expected to be ubiquitous in the next five years, breaking through the trillion-dollar market size. MR serves not only as a new type of media technology but also as a powerful means of information exchange and consumption. It can convey any type of content and can be applied to any field. With the maturity of MR technology and the surge in demand, it is increasingly recognized by the public, attracting significant capital investment and greatly enhancing its market value




Source: MarketWatch




Source: google.com and openstreetmap.org

In recent years, technology giants such as Apple, Meta and Google have made significant investments and acquisitions in areas such as MR hardware and spatial maps, taking MR as the most important development direction of the next-generation Internet and metaverse, combining it with the massive industrial and consumer markets. According to IDC and many other authoritative institutions' analysis and prediction, consumer-grade MR glasses and other related hardware will be released by Apple and Meta in 2024, setting off a new round of spatial Internet revolution, and the MR market scale will rapidly grow to $150 billion in 2025. Humans will exist simultaneously in the digital and physical worlds, requiring MR spatial computing and digital content engine services. The establishment of MR map infrastructure will play a crucial role in the industry

## 1.3 Market Opportunities

Most previous MR applications are Fragmented & Temporary UX, Inaccurate & Floating Positioning, Offline & Single-player, which have very poor experiences, and are not able to form large-scale user interaction. Therefore, globalized MR high-definition maps as infrastructure is highly required, as social interaction needs LBS and autonomous driving needs high-definition maps.


The maps of global services basically are mainly 2D satellite signal maps, and there is no globalized 3D high-definition map for MR spatial internet services in real sense. Google, Meta, Niantic and other companies are heavily investing in global MR 3D high-definition maps, but they are all Web2-centered platforms with expensive commercial fees, small applicable scenarios, complex acquisition and reconstruction processes, limited real-time update capabilities, and most of their maps are not compatible with multiple scenarios requiring MR such as indoor and outdoor at the same time, and the map data and user data of the centered companies face the risk of being exposed to authorities, regulators or governments.


DeMR solves the above problems with a decentralized network and automated AI map reconstruction pipeline, which can collect and reconstruct global full-scene 3D high-definition map data at lower cost with higher efficiency, and provide open spatial interaction services for massive MR applications. The ownership and revenue of the data are shared by global contributors, and the revenue will be continuously obtained in subsequent applications according to the evaluation of contribution volume.

## 1.4 Competitors Analysis

The real world is scarce compared to the online digital world that is expanding infinitely, the physical world that people inhabit is finite and stable, and has increasingly scarcity's value as people migrate digitally. Whether in the physical or digital economy, scarcity is the cornerstone of economics and will become the core anchor point for value creation. MR spatial high-definition map technology is the best way to solve the problem of connecting reality and virtuality, is also a killer app to maintain the scarcity value of the real world and create new imagination and digital traffic, bringing unlimited experiences and efficiency improvement for people's working & living, also as an essential infrastructure for the next generation Internet.

| MR HD-Map Platform | DeMR | Niantic LightShip | Google GeoSpatial | Huawei Cyberverse | Overthereality |
|---|---|---|---|---|---|
| Ultra high precision | ✓ | ✗ | ✓ | ✓ | ✗ |
| Super large scale | ✓ | ✗ | ✓ | ✓ | ✗ |
| Consumer-grade scan | ✓ | ✓ | ✗ | ✗ | ✗ |
| All scenario support | ✓ | ✓ | ✗ | ✓ | ✗ |
| All VR/MR devices support | ✓ | ✓ | ✓ | ✗ | ✗ |
| Full dev toolchains | ✓ | ✓ | ✗ | ✗ | ✗ |
| Automatic AI pipeline | ✓ | ✗ | ✗ | ✗ | ✗ |
| Globally Decentralized | ✓ | ✗ | ✗ | ✗ | ✓ |
| Open ecosystem | ✓ | ✓ | ✓ | ✗ | ✗ |

However, most MR map projects are currently centralized, either unable to achieve high accuracy in spatial computation, or the acquisition and reconstruction process are costly and complicated, requiring the use of expensive professional equipment, centralized time-consuming and laborious acquisition, also unable to achieve low-cost and efficient large-scale replication. DeMR, on the other hand, is based on a completely decentralized network with an automated AI reconstruction pipeline, making it possible for everyone to participate in the construction and enjoy the incomes, using consumer-grade camera equipment for the acquisition, compatible with indoor and outdoor scenes, with centimeter-level high accuracy for spatial positioning interaction.

DeMR has a global leading technology team with experts from MR, ADAS, AI and Blockchain related fields, the team has completed a large number of customer landing validation and data services in the past few years, collected billions of square meters of MR HD map data, and served hundreds of customers in 50+ cities. DeMR Network has the ability to create a massive application of the most advanced spatial computing technology to the global decentralized MR infrastructure platform.

# 2 Technology

## 2.1 Key Features

The DeMR Network has been developed by a global leading MR &AI team for more than 5 years. It has following key features:

1) High-definition

With the help of advanced deep neural network based computer vision technology, DeMR supports centi-meter level spatial localization and interaction.

2) City Scale Support

DeMR has established large scale service capability, supported from room-scale small MR HD Map to city-scale large scale MR HD Map.

3) Consumer Level Scanning

DeMR is in Web3 manner, it is a decentralized network that can be joined by anyone who scans the real world landmark with consumer level devices to earn.

4) Adaptive to Various Environments

With AI models trained from large scale data, DeMR is highly extensible and adaptable. DeMR supports both indoor and outdoor scenes.

5) Multi-device Compatibility

Due to the completion of comprehensive optimization work, DeMR is compatible with most mainstream MR devices, including iOS/Android phones and MR glasses, there will also be a focus on compatibility with Apple Vision Pro in the future.

6) Support for Massive Multiplayer Online Games

DeMR supports massive users joining the network to localize and interact with each other, and enjoy abundant real-time MR experiences.

7) Fully Automatic Mapping Pipeline Aided by AI

One of the core technical advantages of DeMR is an AI aided fully automatic mapping pipeline that builds spatial semantic MR HD maps.

8) Distributed and Decentralized

With the help of advanced pipeline and high-definition low cost CV and MR algorithms, anyone can be a contributor.

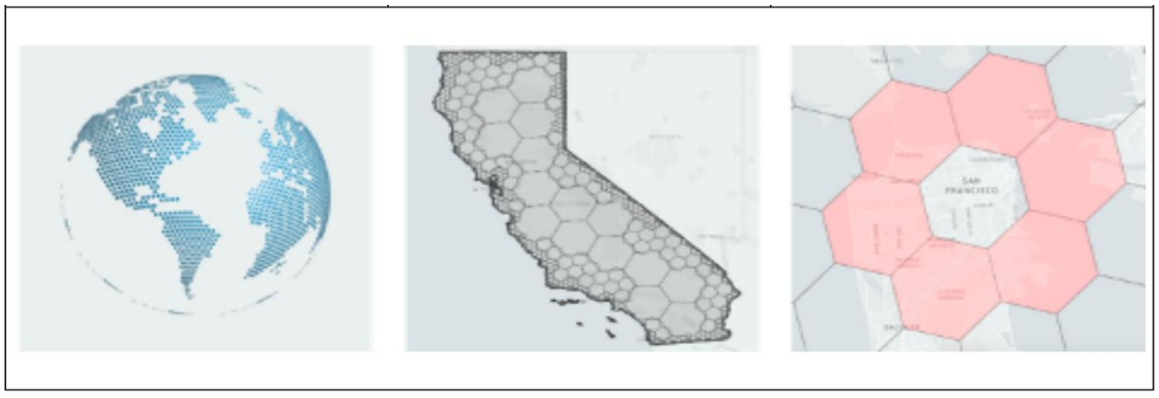
9) Open Ecosystem

DeMR strives to build an open Web3 ecosystem for all MR developers and users globally. The DAPPs in the ecosystem support data asset exchange and interaction between users in real-time, becoming a real earth-scale decentralized spatial Internet.

## 2.2 DeMR Tile

DeMR Network follows the definition in an open source protocol H3 (https://h3geo.org/) to index map tiles. In this protocol, the earth surface is split into adjacent hexagonal tiles, each of which is called a DeMR Tile. In the hierarchical design of H3, adjacent tiles can be combined to a larger Tile.

City Landmarks such as squares, scenic spots, business streets, malls and parks can be mapped to DeMR Tiles of various sizes. Each DeMR Tile has a unique correspondence in real world and thus has inherent sparsity to be minted to DeMR Land NFT. In this way, each DeMR Land NFT is associated with a real world landmark, can make different profit according to the location, business property, cultural value, and popularity of the corresponding landmark, and thus has different pricing in the market.



A DeMR Tile has different states in its life-cycle from undeveloped to minted to support MR experience. The following colors and icons represent different states of a Tile:

| | | |
|---|---|---|
|  | Unknown Foggy | Unopened area |
|  | Undeveloped | Opened area, is being annotation as a land Tile and being prepared for sale |
|  | For Sale | The Tile NFT is ready for sale |
|  | Minted | The Tile NFT is sold |
|  | Scanned | The Tile is scanned and mapped |
|  | Serving | The 3D HD Map for this Tile is serving for AR applications |
|  | Hot Serving | The 3D HD Map for this Tile is serving for many AR applications |
|  | Out of Date | The 3D HD Map for this Tile partially outdated and needs update |
|  | Rewarded | The Tile has associated reward tasks (scanning/annotation/verification) |

## 2.3 MR HD Map

### 2.3.1 MR HD Map Overview

MR HD Map is an important infrastructure for spatial Internet MR application. It is generated by a complex pipeline composed of image and inertial sensor data collecting, computer vision based scene understanding, deep neural network powered visual feature extraction, intelligent image matching and 3D reconstruction. By using MR HD Map, user devices such phones, pads, and MR glasses can understand surrounding environments and perform continuous spatial positioning to support multiplayer MR interaction. Being different from other positioning technologies such as GPS, WiFi and Beacon based technologies, which have precision of at least 1-10 meters, MR HD Map has precision up to centimeter level with 6 degrees of freedom, it is accurate enough for abundant persistent MR scene applications and multi-player interactions.

| | | |
|---|---|---|
|  |  |  |

MR HD Map is the core to MR applications and an important infrastructure in the spatial Internet Era. With the help of MR HD Map, consumer devices such as phones, pads, and MR Glasses can recognize visual features of its surrounding to deduce its location and orientation magically, so that digital MR contents (such as videos, models, virtual human, special effects, informative signs, etc.) can be precisely superimposed and anchored in real world space. MR interaction without MR HD Map can be fragmented, temporal and isolated because devices can't continuously position themselves in real-world large-scale space and understand the changes in its surroundings. Without precise positioning, MR content is looking unreal and floating in space. Without the common coordination of MR HD Map, multi players could not share a common space to interact, MR applications may become single player games. Therefore, the earth scale MR HD Map is the essential infrastructure in Web3 spatial Internet Era.

### 2.3.2 MR HD Map Pain Points

There are difficulties and obstacles of MR HD Map that prevent it from being commercialized in large scale due to involving complex technologies such as computer vision, artificial intelligence, and distributed system engineering.

1) Efficiency of Producing MR HD Map

Traditional procedure of producing MR HD Map requires professional surveying-grade devices with expensive Lidar, and requires professional operators. This procedure costs too much for large scale commercial applications.

2) Reconstruction Performance of MR HD Map

The application scenarios of MR HD Map include scenic spots, museums, business streets, malls, city parks and etc., which involve people's everyday life. Considering the scale, visual condition, lighting condition and dynamic visual interference in different scenarios, the model needs intensive testing and optimization involving large amounts of real world data. For example, training a deep neural network for extracting local and global features from images to adapt to different

lighting conditions and different space scales; Image matching is the basis of 3D reconstruction, and it is necessary to adjust the image matching strategy according to the multiple influence factors in order to filter out false matches.

Besides, in order to support large-scale mapping, GPU-based optimization should be involved in the majority of steps in the whole pipeline, such as feature extracting, image matching, image recalling, bundle adjustment etc.

3) Optimization for Visual Positioning

The performance of MR HD Map also needs to be synchronized and optimized for relocation (the process of collecting image data through the camera of electronic devices such as mobile phones/Pads/VR/MR glasses, which is used to calculate the current 6DOF pose of the device ). For example, GPU-optimized efficient image retrieval, which can quickly retrieve correct candidate keyframes from thousands of map frames on the mobile terminal; automatic scale correction means that the scale of the tracking system on the mobile terminal is determined by the inertial measurement unit (IMU). However, the VIO algorithm on the mobile terminal has undergone a lot of optimization and careful calibration, there will still be an error of 1-5%. If the scale and the map scale are inconsistent, it will lead to systematic errors in the relocation calculation.

4) MR HD Map Needs Constant Updating

During the practical application of MR HD Map, the visual features of the space change frequently, for example, new stores, new billboards, renovation or reconstruction of buildings, and so on. After the visual features exceed a certain percentage, the MR HD Map needs to be updated, especially when it happens out-of-town or abroad, the MR HD Map update work will become difficult and pay higher labor and transportation costs.

After many years' research and development, DeMR Network core development team has achieved many technical breakthroughs regarding spatial intelligence and highly concurrent distributed systems. The problems above are well solved.

## 2.3.3 Value of MR HD Map

The earth-scale visual positioning and spatial computing system based on MR HD Map will be the information engine and important infrastructure of the next generation Internet. The essence of the Internet and Metaverse are both information and value exchange between humans and the world. In the past 20 years of the Internet, the information exchange engine brought the revolution from Web1 to Web2, the information media evolved from one-dimensional text/audio/sms/webpage to two-dimensional image/video/live video/APP, to three-dimensional MR/VR experience.

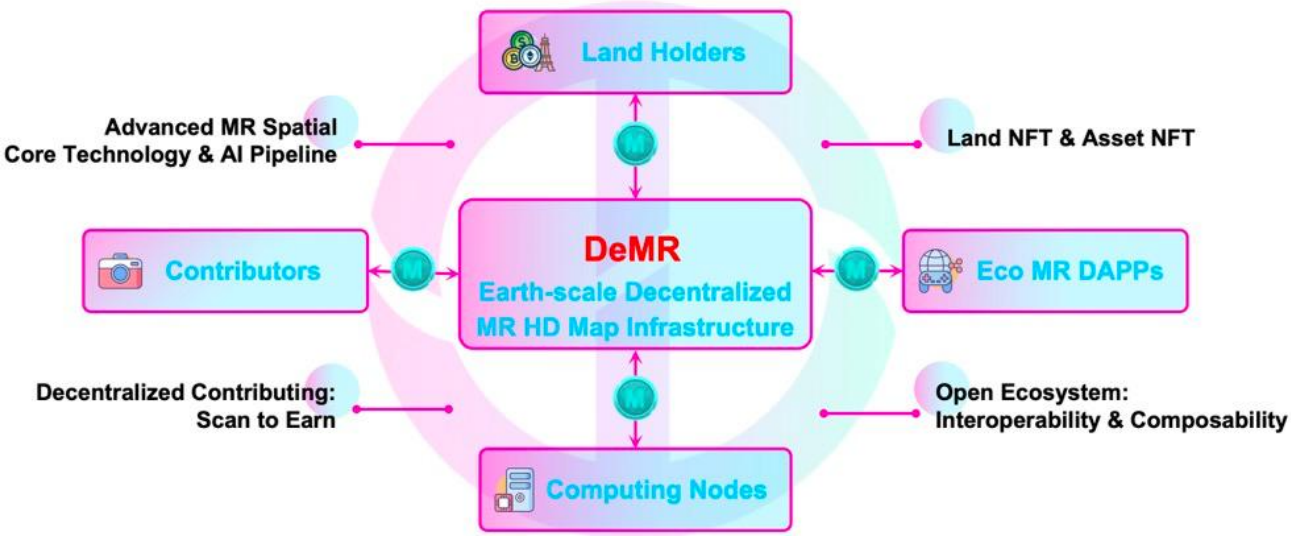
Information engine has evolved from one-dimensional web portal/search engine, to two-dimensional recommendation system/LBS, to ubiquitous three-dimensional spatial computing. Internet nodes, circulation, content, protocols, information engine, interaction portal are rapidly evolving, there will be big impacts on society and economy in the future.

| Internet Properties | Web1.0 | Web2.0 | Web3.0 |
|---|---|---|---|
| **Nodes** | Web Sites | Homepages & Stores | **Avatars & DAOs** |
| **Edges** | DNS & Links | Follows & Likes | **Addresses & Spatial Index** |
| **Flow** | HTML Pages | Images, Videos | **Tokens & Experiences** |
| **Storage** | Servers | Clouds | **Blockchains** |
| **Protocol** | TCP/IP & HTTP | MAP & MMP | **SIVE & HSTP** |
| **Dimension** | 1D & Unidirectional | 2D & Bidirectional | **3D Spatial & Multidirectional** |
| **Content Discovery** | Directory & Search | Social & Recommendation | **Spatial Computing & AI** |
| **Entry** | PC & Browsers | Phone & APPs | **VR/ MR & Metaverses** |
| **Dominant Platform** | Yahoo, Google | Meta, ByteDance | **Niantic ?, DeMR** |

## 2.4 DeMR Solution

DeMR combines the most advanced Web2 MR& AI core technology with the idea of Web3, to build an earth-scale MR HD Map-based metaverse ecosystem combining virtuality and the real world.

The decentralized earth-scale MR HD Map infrastructure built by DeMR is serving all global users and Web3 applications.



1. Decentralized Holding and Building

DeMR maps each landmark in the world (including squares, scenic spots, business streets, malls, city parks etc.) to a DeMR Tile according to its actual location and size. Each DeMR Tile is unique, and can be minted to land NFT. Land Holders can buy any land NFT around the world, holding it for continuous incomes. When an MR HD Map built upon a real world landmark is used by DeMR API, the corresponding land NFT will generate profits. Therefore, Land Holders can accelerate network building and economic flow by posting map building tasks so that their lands can be built as MR HD Map as soon as possible.

2. Global Distributed Network

DeMR Network contains an advanced spatial computing engine and distributed AI-based pipeline. Global Contributors can claim map scanning tasks through DeMR Network according to their location. When they claim a task, they go to a specific landmark to scan the real scene and then upload the collected data to the DeMR Network. Afterward, the decentralized map reconstruction pipeline is triggered, and the task is split and distributed to Annotators, Reviewers, and Computing Nodes. When the map reconstruction pipeline is finally completed, Validators will check the final MR HD Map. The successful MR HD Map is published to DeMR open ecosystem and it becomes available for global developers. The used map will generate rewards for related participants.

3. Open MR DAPPS Ecosystem

Global developers can develop MR DAPPs on DeMR Network with its API Service and SDK. The DAPPs can be published as DeMR DAPP Featured Content or independent Ecosystem DAPPs. Developers are charged in DMR by DeMR Network when they gain user traffic or earnings by using DeMR services. The fee will be mainly used as an incentive for ecosystem participants. The DAPPs on DeMR can interact with each other, and corresponding assets are interchangeable. The DAPPs are even capable of calling each other and being embedded in each other, finally implementing earth-scale connectivity.

4. Distributed Computing and Data Nodes

DeMR MR HD Map requires a large number of computing units and storage units from scanning to reconstruction. Users also need a huge amount of cloud service computing nodes to support when accessing MR application services through terminals. The computing nodes around the world provide distributed computing resources for DeMR Network while storing data in the distributed ledger. Each node can store a complete replica of the distributed ledger, and any user

can access the data and view all the transactions performed or stored in DeMR Network, ensuring the accuracy and reliability of the data to the greatest extent.

Consumers need to pay to use MR DAPPs in DeMR Network on their own phones, pads or MR glasses. DeMR Network earns from Developers and Consumers, then rewards Land Holders, Contributors, and Computing Nodes continuously. The earnings of MR spatial Internet from spatial ADs, spatial e-commerce, spatial games, and spatial social media will be as much as one hundred billion dollars, it will become a strong positive externality that powers DeMR Network economic circulation. The DeMR Network will become the next-generation decentralized global network.

## 2.5 Technical Principal

DeMR Network has many years of technology accumulation, its core engine adapts innovative decentralized MR HD Map reconstruction pipeline, significantly reduces production cost and barriers for participants, greatly improves economical value and commercial feasibility.

### 2.5.1 Technology Benefits

With DeMR's powerful high-precision map engine and map building pipeline capability, MR HD Map achieves centimeter-level positioning accuracy. Compared with other companies that need professional equipment and professional acquisition personnel worth more than 100,000 USD to collect MR HD Map image information, we only need a panoramic camera and cell phone worth about 500 USD, and ordinary persons can master the image acquisition method through 10 minutes of self-learning. For example, the acquisition time for a room of about 100 square meters is 3-5 minutes, for a venue of about 1000 square meters is 5-10 minutes, and for a mall of about 100,000 square meters (mainly the public area, excluding the internal area of each store in the mall) is 1-2 hours.

| | | |
|---|---|---|
| Conventional Solution |  | Needs expensive devices to scan. The device can cost up to 100k USD<br><br>Requires specialized professionals<br><br>Operated on centralized platform and hard to operate globally |
| DeMR Solution |  | The device costs only about 500 USD<br><br>The device costs only about 500 USD<br><br>Operated in decentralized Web3 manner, easy to cover globally |

## 2.5.2 Best Practice for Scanning

Considering the complexity of MR scenes and the limitations of consumer devices, the DeMR team has done lots of work on spatial computing and AI technology. The DeMR team is the first to release a pure image-based scanning method that is suitable for most city landmarks, and it also provides the best practice guidance. The procedure is composed of following steps:

1) Feature Evaluation for Landmark

Landmarks should have scenes with a stable spatial main structure, and choose visual features with unique recognition or lower repetition. Also, it needs to pay attention to the appropriate brightness of the collected ambient light and the matching degree when using MR applications, etc.

2) Scanning Device Settings

Choosing low-cost, high-speed, and effective capture devices, we optimize a large number of combinations of device resolution, frame rate, exposure, and video coding format to obtain the best configuration of parameters.

3) Camera Position for Scanning

When scanning on site, the camera orientation should be adjusted to point and cover the most important parts of the scanned object and space. For scenes of normal height, it is recommended to raise the camera to the position just above Scanner's head.

4) Scanning Route

Landmarks with different layouts have different routes of recommendation. As a rule of thumb, it is important to scan in a looped manner. In a wide open area, the route should be like an S shape and dense enough to cover the space. For multi-story buildings, such as a shopping mall, different floors can be connected via a route on open elevators.

5) Exporting Data and Upload the Data

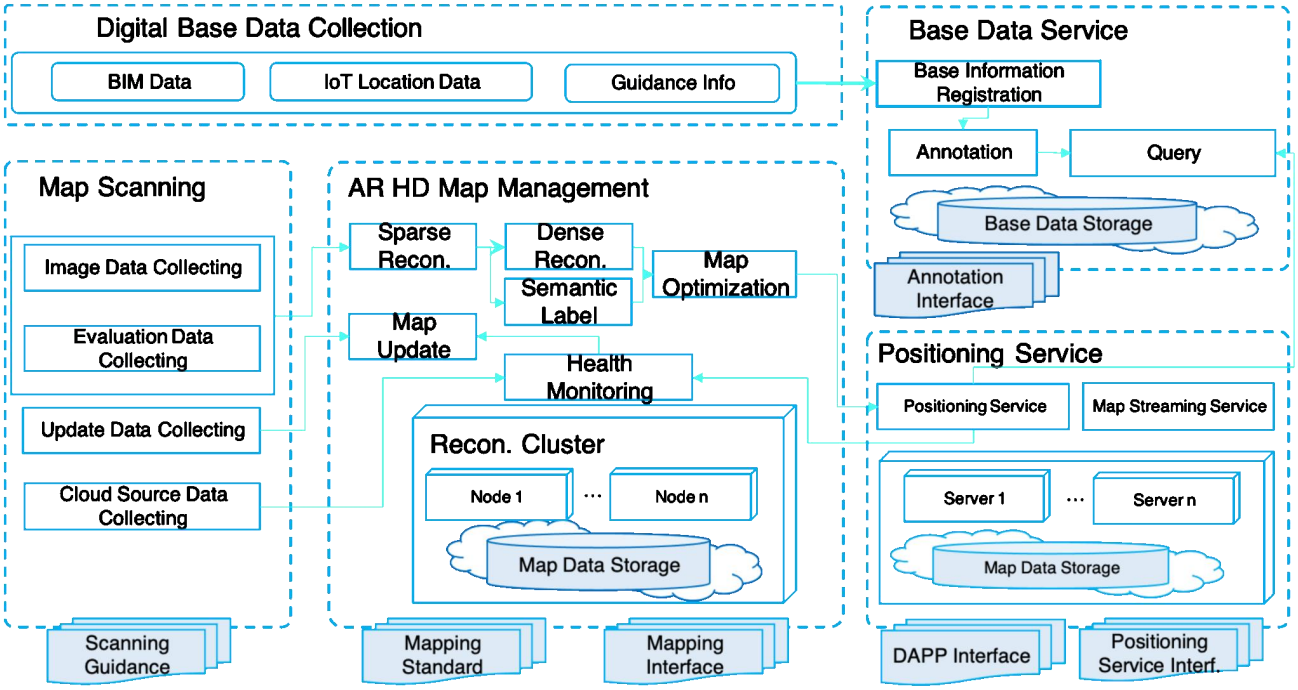
When exporting video data, the image stabilization function should be disabled, stitching function should be set to its best performance. The output video should be accelerated 5-15 times to minimize file size. The output file should be updated to DeMR Network according to the prompt on DeMR DAPP or the official website.

At present, DeMR HD Map can support most city landmarks, such as squares, business streets, shopping malls, theme parks, museums, galleries, scenic spots, ancient towns, etc.

### 2.5.3 Distributed Computing

DeMR Network powers reconstruction tasks and real-time service for MR HD Map all around the world via its powerful distributed computing capability. Each Computing Node runs components of the DeMR cloud service. The components include a deep neural network-based image feature extractor, image matcher, structure from motion component that estimates images poses and sparse map, and map densification component. The distributed cluster splits a reconstruction task into several sub-tasks and distributes the sub-tasks to different Computing Nodes. The tasks are supervised and managed by decentralized nodes. On each Computing Node, the reconstruction algorithm can take advantage of the heterogeneous computing capability of multi-core GPU, GPU, and NPU (if available). The results are collected to build the final map. A high-quality MR HD Map is finalized after tens of steps including several rounds of refinement.

The distributed map reconstruction procedure ensures the high efficiency of map building. It takes only a few hours to complete the whole process of rebuilding a city block while guaranteeing centimeter-level precision. The cluster is decentralized and dynamically scalable, multiple DeMR reconstruction tasks can run simultaneously, Computing Node resource is utilized maximumly, and the computing cost is reduced significantly.




DeMR Network contains loads of advanced technologies including heterogeneous computing of multi-core GPU, GPU, and NPU, large-scale Structure from Motion (SfM), semantic SLAM, 6DoF tracking, and massive multiplayer online interaction. Building upon these technologies, DeMR can support city-scale and even earth-scale mapping services. DeMR provides open API and development tools for global developers to develop abundant MR DAPPs, building a wonderful future spatial Internet.

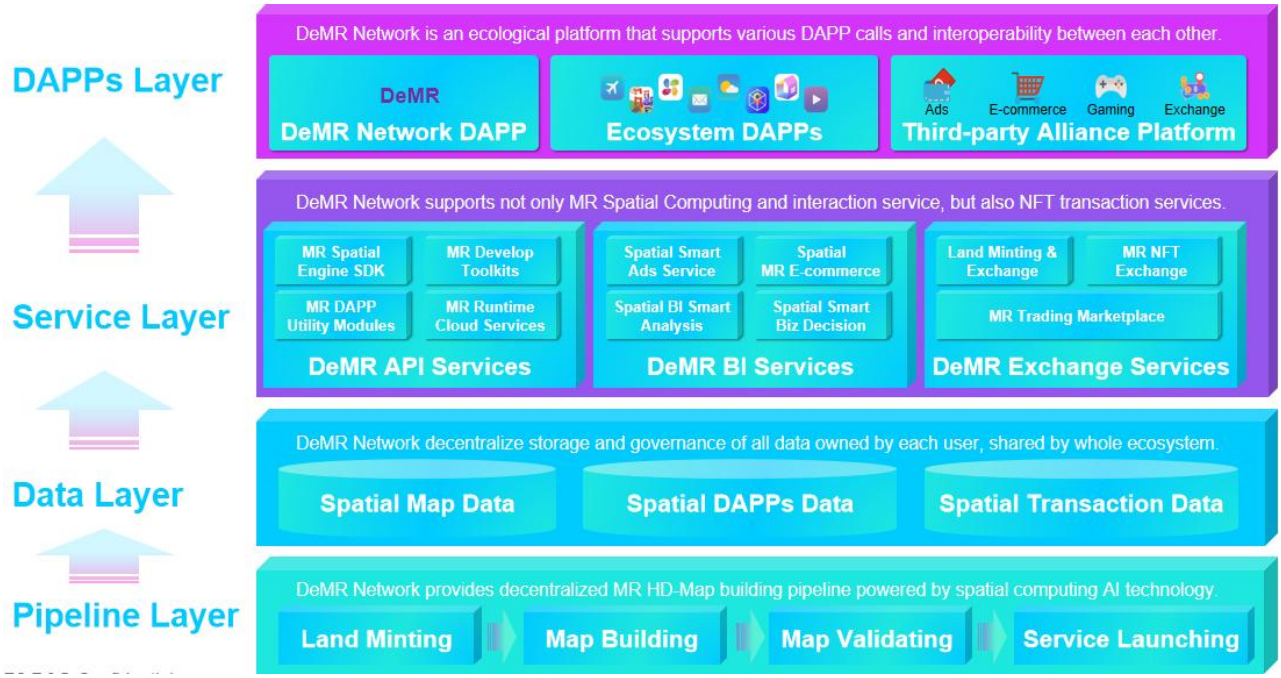
## 2.5.4 Decentralized Scanning and Reconstruction

DeMR builds MR HD Map Network in a completely decentralized way, so it can efficiently cover main city landmarks and update MR HD Map, thus guaranteeing global service quality and data up-to-date.

DeMR global Contributors can claim map scanning tasks through DeMR Network according to their location. When they claim a task, they go to specific landmarks (such as squares, scenic spots, business streets, shopping malls, city parks, etc.) to scan the originals, then upload the collected data to the DeMR Network. Then the decentralized map reconstruction pipeline is triggered, and the task is split and distributed to Annotators, Reviewers, Computing Nodes, and Validators. When the map reconstruction pipeline is finally validated, the MR HD Map is published to DeMR open ecosystem and is available for global developers. The used map will generate rewards for related contributors in DMR.

## 2.6 Architecture

After many years of R&D and commercial validation, DeMR Network has evolved to a professional and efficient 4-layer architecture, which includes Pipeline Layer, Data Layer, Service Layer, DAPPs Layer.




1. Pipeline Layer

DeMR Network encapsulates a large number of complex spatial computing, environment awareness, artificial intelligence, MR interaction, and other technologies, and establishes a decentralized MR HD Map acquisition and construction pipeline. After the construction and release of the map, DeMR Network will automatically reward each contributor according to the data source and the evaluation of the contribution.

2. Data Layer

DeMR Network stores and manages the MR HD Map data, spatial DAPPS, and spatial transaction data from different locations in a distributed manner. All the data belongs to ecosystem participants, and it is governed by the whole community. In Data Layer, Computing Node provides distributed computing resources for map reconstruction and API services. Computing Node is rewarded by contributing computing results.

3. Service Layer

DeMR Network supports the DAPPs in its ecosystem to use any MR HD Map-based technologies. DeMR API Services provide MR Spatial Engine SDK, MR Developer tools, MR DAPP components, and MR visual positioning service to global developers. DeMR BI Service is designed for advertisers and merchants, containing services for spatial advertising, spatial e-commerce, data analysis, and business intelligence. Exchange Service is designed for all users in DeMR Network, providing secure and convenient service for NFT minting, auction, task and bounty, and NFT trading in the MR world.

4. DAPPs Layer

DeMR Network is an open decentralized global ecological network that supports a large number of DAPPs to use API services and interact with each other. DeMR Network provides a unified portal (DeMR DAPP), enabling Contributors, Land Holders, Computing Nodes and Developers to check their assets, tasks, rewards, and available services.

DeMR Network provides easy interfaces for developers to create and operate all kinds of independent DAPPs. These applications can call each other and support asset exchange with each other. DeMR will also support other platforms including alliances for ADs, e-commerce, game, and trading. DeMR is a completely open-minded infrastructure for the global DeMR ecosystem.

## 2.7 DeMR DAPP

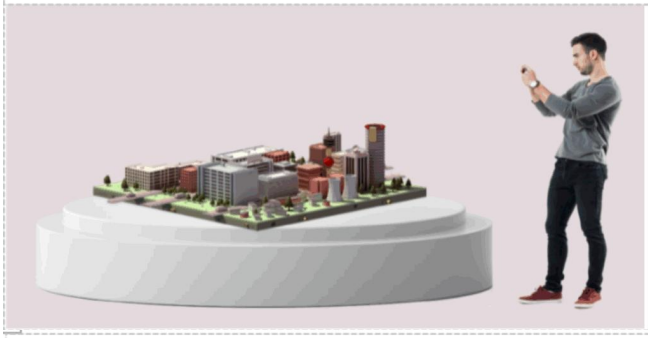
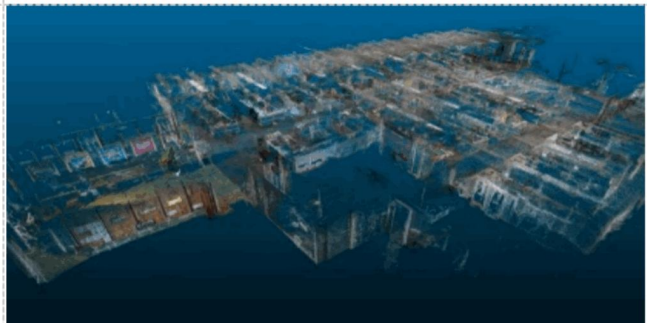
DeMR Network provides a convenient portal for participants and users to access, including DeMR DAPP and DeMR Web, where Contributors, Land Holders, Computing Nodes, Developers, and Users can access their own digital wallets to view and manage their plots NFT, tasks, rewards, applications, etc.

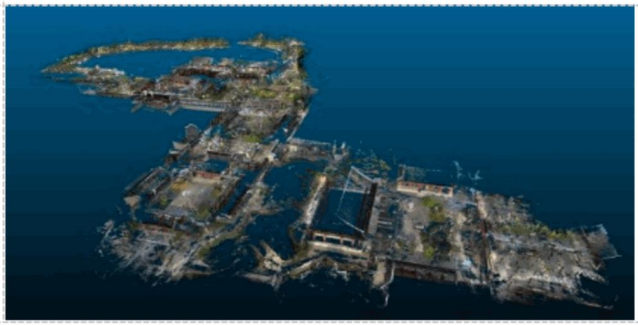
DeMR Network attaches great importance to the positive externalities of the network and the introduction of real-world traffic and Web2 traffic, providing the ability to generate a wallet with a convenient one-click log-in to a Web2 account. DeMR DAPP has both wallet and trading functions, and the DMR revenue gained by users and the NFT gained in the Eco-application will be deposited into the DeMR DAPP account.

## 2.8 Use Cases

The technology of DeMR is compatible with the whole scene, which is suitable for high-precision MR multi-person interactive experience in the following scenarios: small scenes at the desktop and room level, and super large-scale scenes at the venue and street level, etc., which can meet the requirements of squares and scenic spots. MR HD Map creation and MR application

positioning conditions are satisfied for most indoor/outdoor scenes such as commercial streets, museums, shopping malls, etc.

| Desktop level (desktop, real estate sandbox, etc.) | |
|---|---|
| Sand table scene | Sand table 3D HD Map |
|  |  |
| Room level (room, office, small showroom, etc.) | |
| Room scene | Room 3D HD Map |
|  |  |
| Venue level (museums, shopping malls, etc.) | |
| Shopping mall | Shopping mall 3D HD Map |
|  |  |

| Street level (commercial streets, cultural and tourist attractions, theme parks, etc.) | |
|---|---|
| Commercial street | Commercial street 3D HD Map |
|  |  |

DeMR has also optimized computer vision algorithms in light and dark environments to a certain extent, which can meet the use of specific scenarios.

| Dimly lit scene | |
|---|---|
| The original scene of a museum | 3D HD Map |
|  |  |

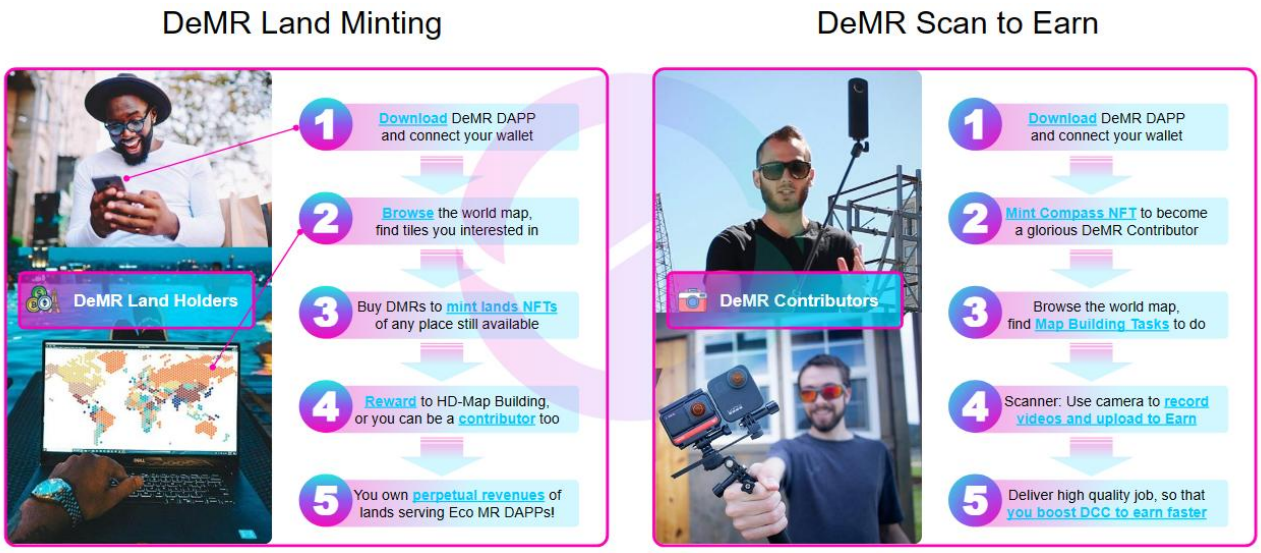
# 3 DeMR Pipeline

There are various important ecological players in DeMR Network, including Land Holders, Contributors, Computing Nodes, Developers, etc.

## 3.1.1 Land holders

DeMR's land represents the infrastructure of Web3 Spatial Internet and the only scarce asset corresponding to the real world, as well as the possible commercial interest to build MR content ecology in the future. Land Holder is an important role in DeMR, with their active participation, DeMR may generate more economic incentives for the community to realize a better, amusing, interconnected and ecologically active MR world.

At the initial, DeMR Lands will be officially opened in a limited number of parcels in designated cities, and Land Holders will receive the lands that are bound to real-world geospatial locations after land minting on DeMR DAPPs, which can then be scanned and map-built by contributors to form a link in the global MR infrastructure network. Land Holders could choose to provide additional incentives for tasks such as land building and DAPPs development that enhance Land's economic rights and interests, and other users trade lands and continue to enjoy ecological benefits. At the same time, Land Holders can participate in the subsequent tasks of DeMR Network, such as map scanning and map building, and maintain the land after the successful construction of 3D maps to obtain more revenue.




## 3.1.2 Contributors

To ensure that decentralized collaboration produces high-quality global 3D high-definition maps, there are multiple Contributor roles in the DeMR Network, including :

➔ **Scanner**

Receive the map collection task, collect the original panoramic map data and calibration data by devices such as panoramic cameras or mobile phones, and get the task reward DMR.

➔ **Annotator**

Receive the annotation task and annotate the collected map data with scene POI information, such as street names, store names, etc., and receive the task reward DMR.

➔ **Reviewer**

Receive the review tasks, reviewing map data, including panoramic map data review,

checking and dealing with illegal data, invalid data, spam data, non-standardized data, etc., then receive the task reward DMR.

➔ **Validator**

Receive the validation task and verify the spatial positioning and MR interaction effect of the completed 3D high-definition map in the simulated environment and real world through DeMR DAPP on-site, then receive the task reward DMR.

➔ **Trainer**

Each role has a corresponding reputation value DCC (DeMR Contributor Credit). When the DCC reaches a certain level, you can upgrade to the trainer and get additional rewards by training other novices. Novices have a lower initial DCC with a lower incentive bonus, which will be significantly increased if with a paired trainer.

### 3.1.3 Computing Nodes

DeMR Computing Node is a vital computing unit and storage unit in DeMR Network, which is responsible for storing the input data in the distributed ledger, performing a large number of AI parallel computations, and ensuring the correctness and reliability of the data. Each node stores a full copy of the distributed ledger. Any user can access the data and view all the transactions performed or stored in DeMR Network.

DeMR Computing Node performs large-scale AI running CPU+GPU+NPU heterogeneous parallel computing, providing map building process service capability, cloud server storage resources and MR real-time spatial positioning capability. DeMR MR HD Map requires a large amount of computing resources in the pipeline from scanning to reconstruction, and the images are feature resolved to calculate spatial 3D point cloud high-precision map and upload it to the cloud service, while the cloud service also needs to run on the cloud Computing Node. Each MR service in the application layer requires user access from the terminal and feature extraction through the camera in real time, and these calculations also require the support of cloud Computing Nodes. Each DeMR Computing Node can get DMR token incentive by contributing computing resources.

DeMR Network effectively manages Computing Nodes, makes distributed backups of data to prevent node errors, and imposes severe penalties on malicious nodes, such as forfeiting staked DMR from nodes that contribute to cheating or maliciously modifying data.

### 3.1.4 Developer

Developers contribute to the DeMR Network by paying DMR to access services such as MR map location and spatial computing, as well as constructing their own MR Spatial Internet DApps. This results in the creation of a vast, globally decentralized MR infrastructure that employs cutting-edge spatial computing technology. Additionally, it establishes a network of interconnected applications and spatial traffic on a massive scale.

## 3.2 DeMR NFT

Many different NFTs are supported in DeMR Network, including Compass NFT, Node License NFT for computing resource nodes, Land NFT for each DeMR parcel, and NFT for spatial assets in all DeMR supported MR scenarios and DAPPs such as Art NFT, Cultural Tourism NFT, Game NFT, Social NFT, etc. According to the open implementation phase of DeMR Network, users can directly issue, mint, and trade NFTs in DeMR DAPPs.

### 3.2.1 Compass NFT

Compass is the core NFT in DeMR, which is the necessary identification for contributors, such as the sword in the hands of a warrior, the shoes on the feet of a runner, and the walking stick of a wizard. Anyone who wants to become a network contributor needs to purchase a DeMR Compass. In the early stage, DeMR officials will sell NFTs in limited quantities in phases on the official website, and users can purchase them directly and obtain the relevant rights. The higher the reputation value of DCC (see DCC chapter for details), the higher the reward factor of NFT will be.

➔ Compass Renting

Compass holders are allowed to lease their Compass to users in different regions for Scanning or other processes and share the benefits with the users. DeMR supports Compass leasing guilds and city DAOs in different regions, which are responsible for Compass leasing and training for map scanning in each region to promote the successful construction of global MR spatial map and application’s ecology.

### 3.2.2 Node License NFT

The future MR world construction requires a large amount of spatial computation, real-time perception, and interactive rendering, thus a large number of computing units and storage units are needed, and the security and reliability of Computing Nodes are important. Therefore, computing resources need to stake a certain amount of DMR and mint it to get the Node License NFT, which

symbolizes the identity, to become a DeMR Computing Node. Each Node continuously contributes computing resources to DeMR Network and gets DMR rewards.

DeMR is committed to building a profitable global spatial computing infrastructure service network. The reward system of Node License NFT is directly related to DCC, and the credibility value of nodes is crucial to the calculation of node pledging and node contribution rewards.

### 3.2.3 Land NFT

To accelerate the construction of global MR spatial computing infrastructure efficiently, DeMR defines adjacent hexagonal Tile partitions for the whole earth surface, each Tile is a DeMR Land NFT, and seven adjacent Tiles can be built into a larger Tile, which means that Land NFT also supports combination and splitting. NFT is not only a spatial coordinate positioning system for VR and MR content, they are also the basic digital assets of the future world, and could be used to generate more economic incentives for the community for better development in the future through its scarcity and trading.

In the early stage, to ensure the effectiveness of the project's cold start operation,DeMR Land NFT will be offered by the official in a limited number of cities on the official website. DeMR land is defined by the geographical location where it is located, and also provides a global three-word address index or four-word address index system for location in a human language that is easy to read and remember. DeMR land will be minted by Landholders, all land assets will be recorded on the DeMR blockchain network, enabling decentralization and censorship resistance. The DeMR land asset mechanism will provide economic incentives for generating, distributing, and curating high-quality MR and VR content and building the future globalized spatial internet world.

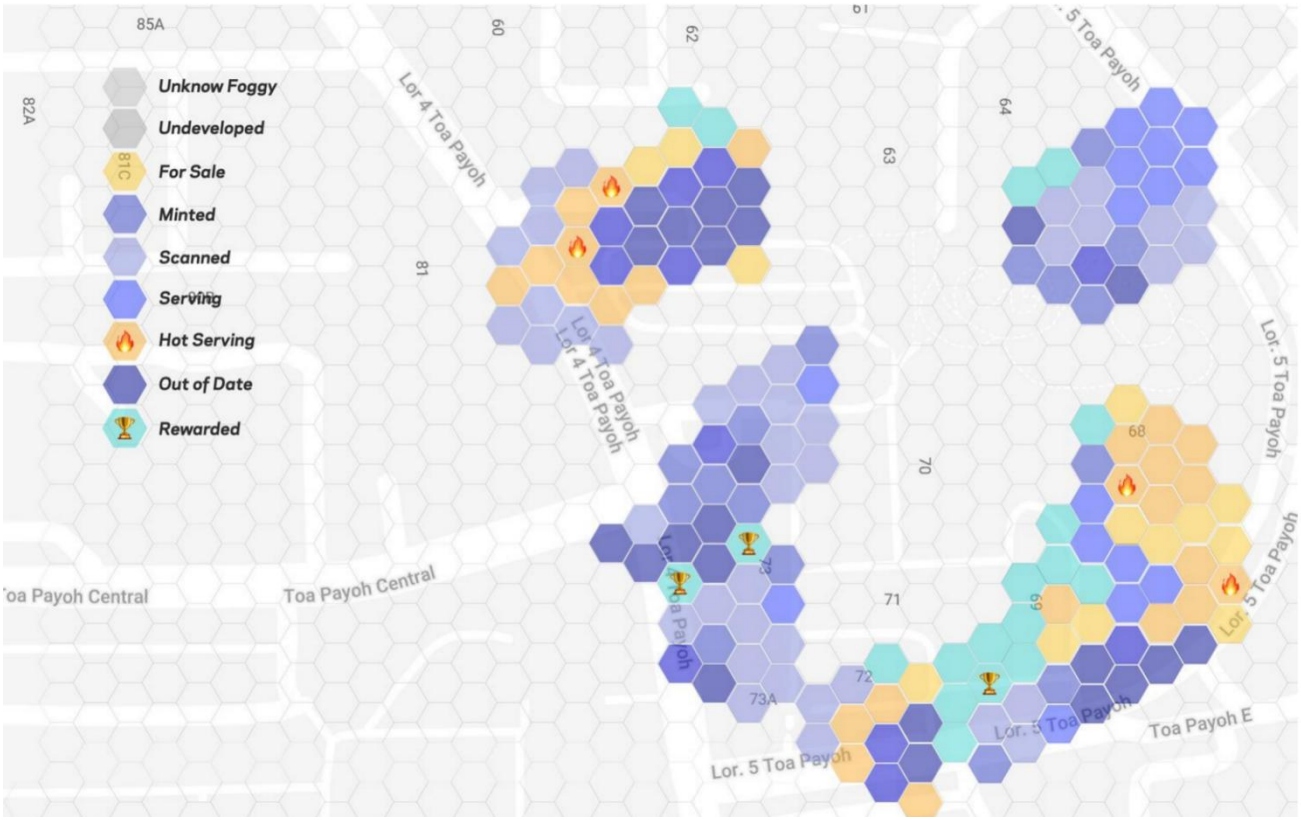
The land assets held by DeMR Land Holders will be marked on the DeMR Network map with real-world locations, and enjoy a share of the revenue from the subsequent MR application experience and eco-content construction of the land.

## 3.3 DeMR Decentralized Pipeline

### 3.3.1 Process


Each participant needs to create their own DeMR account on the DeMR official website or DAPP, which can be done by binding a decentralized wallet or automatically generating a new decentralized wallet with an authorized login by the Web2 account, after which they can participate in DeMR's map construction. For the land that has been opened or uncollected reconstruction status, after Land holders minting, Scanners could use the consumer-grade camera or HD mobile phone to scan the real-world parcel and upload the collected HD scene image data with calibration data in DeMR DAPP or Web portal. After clicking [Application Processing] to start the decentralized map reconstruction processing pipeline, DeMR Network will organize contributors including annotator, reviewer, and validator with Computing Nodes run by automated AI algorithms to build and launch the map. The main process includes the following core processes:

➔ 1. Land Minting




Land Holders can browse and purchase the open Land NFTs in DeMR Network around the world through DeMR DAPP or by binding their wallets on the official website, mint the land to get the right to earn and trade the Land NFTs. Land Holders will be able to release map bounty tasks to accelerate the realization of their Land interests.

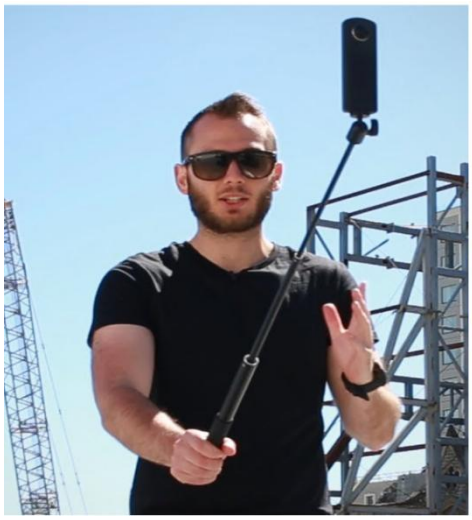
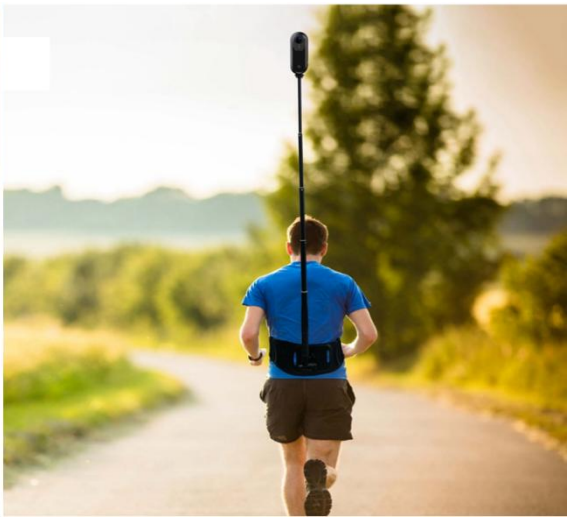
The construction of spatial maps does not strictly depend on Land Minting. Contributors can also complete the collection and reconstruction of plots before land minting. Land Holders and Contributors will obtain a series of rights and interests related to Land, including space ownership of land, future ecological income, etc.

➔ 2. Scanning

After the land minting or the official bounty instruction, the map scanners are motivated to scan the corresponding land. The map scanner collects raw panoramic video data and calibration data through consumer-level devices such as panoramic cameras and HD cell phones and uploads them to DeMR Network for subsequent data processing.

Land that has not been minted or rewarded, as long as it is an officially opened area, can also be scanned by the map collector and processed by a series of DeMR Pipeline to generate an MR

high-precision map, after which the land can still be minted and subsequently traded and shared by the land Holders.

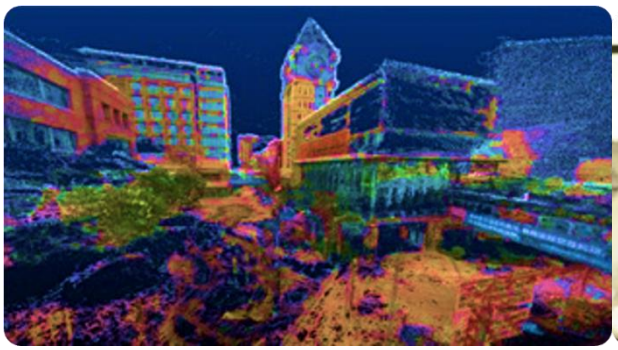



➔ 3.1. Annotating

Through their DeMR accounts, annotators can see the flow of data tasks assigned to them or apply for more tasks and get incentives by completing the annotation of parcel-related information. DeMR will gradually introduce the ability of AI annotation to improve the efficiency and quality of work.

➔ 3.2. Reviewing

The reviewers can see the data flow assigned to them through their accounts, and check whether the data contains sensitive data, illegal data, junk data, non-standardized data, etc., to complete the review and get the incentive. DeMR will also have some automated review AI processes to improve the efficiency and quality of work.

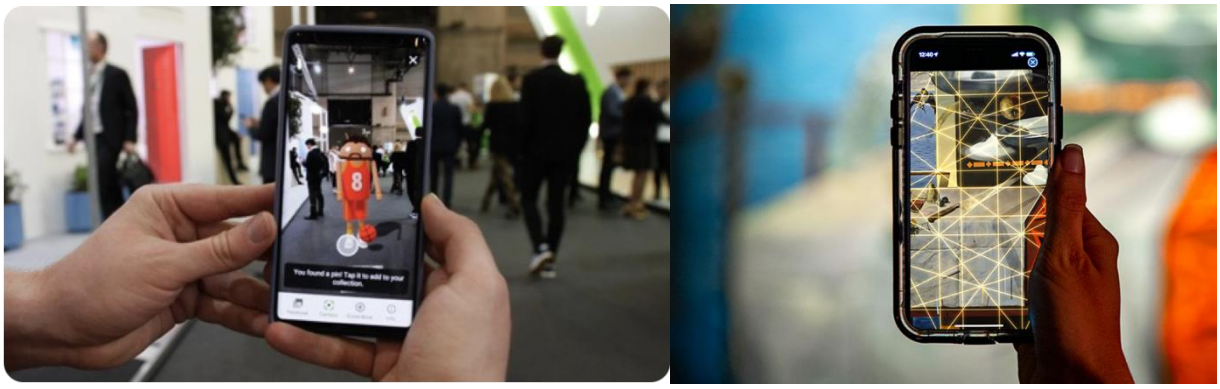



➔ 4. Reconstructing

Map construction and collection are very important steps in the DeMR Decentralized Pipeline. The construction process requires a lot of GPU+CPU computing resources and is completed by the DeMR Computing Node. Through the data of the annotating and reviewing, it officially enters the map reconstruction pipeline, and DeMR Network automatically allocates corresponding computing resource nodes to perform automatic AI feature extraction and reconstruction in dozens of steps. After the map reconstruction is completed, it continuously provides computing resources. Computing Nodes with server resources will receive DMR incentives.

➔ 5. Validating

The successfully reconstructed map is verified by the validator with DeMR DAPP in the simulated environment and the real world. DeMR ensures the quality and fidelity of MR map reconstruction and provides robust and effective service for subsequent MR applications, the validator needs to place and interact with specific virtual objects in the real space to test the stability and accuracy of map positioning. After the validation work is passed, the automated deployment of the map will be activated to go live.



➔ 6. MR Map Service

Maps that have passed the validating process can be automatically launched by DeMR Network, and used by developers to develop their own MR DAPPs through open APIs or to publish content on DeMR official DAPPs. Developers need to purchase and pay DMR to obtain services. DeMR Network will automatically count the frequency of use and popularity of maps in different regions and give contributors further DMR incentives based on the frequency of use, traffic, and output value. After the completion of the global map reaches a certain level, DeMR will gradually open more map-based related services and ecological content to serve the majority of users to meet the needs of different users.

## 3.3.2 Devices

To get rewards by completing efficient acquisition work, map scanners need to acquire a panoramic camera acquisition device or use their own HD mobile phones in addition to Compass NFT. DeMR has no intention to develop and produce specific mining acquisition cameras in the short term, and contributors can complete the acquisition process in DeMR Pipeline through consumer-grade panoramic cameras. Our goal is to build a global Web3 infrastructure with the highest efficiency and quality.

Recommended shooting parameters: 4K, anti-shake off, 3840×1920@30fps, 2560×1280@60fps, 2048×512@120fps

As a global Web infrastructure service network, map coverage is significant, especially in the early stage. DeMR gives the corresponding judging criteria for the Tile status, traffic, and status of different parcels. For areas with high demand and high popularity and traffic, DeMR encourages map scanners to collect more needed maps by the following types of impact factors.

➔Tile Novelty: whether the map of the area has been collected, with priority given to encouraging uncollected areas

➔Tile Demand: the extent of demand for the map, including official operation demand, demand by specific users, popularity demand, etc.

➔Monoblock Region Integrity: All contributors who complete all maps in a given region receive an additional incentive

## 3.4 Tile Novelty

Tile novelty promotes a focus on uncollected areas of the global map, driving broader global map coverage by strengthening the weight of rewards for under-collected areas. This will be one of the strongest factors driving token revenue in DeMR Network over a while.

At the early stage, the Tile Novelty factor in the token rewards for all plots in a given area is equalized, while as certain plots are captured and validated, the Tile Novelty factor will weigh down the rewards for those plots, while the rewards for the remaining plots that have not been captured will be weighted up, thus incentivizing scanners to change their scanning routes accordingly.

### 3.4.1 Popularity

Due to the density of different areas of the surface residential population, economic activity, development, and other density differentiation of Popularity are very important incentive indicator dimensions, including global popularity and specific popularity:

➔ Areas with a high density of population and economic activities, such as the core business district areas of international cities

➔ Uncollected areas that are designated by specific customers or applications, with additional DMR bounty incentives for scanners.

➔ The number of times that the map is used, the number of applications, etc.

➔ Investment for map pledging

## 3.5 Map Quality

The quality of map acquisition reconstruction is critical to building a global infrastructure service. DeMR provides a series of metrics to measure the quality of raw map data, which are used as weighting factors to calculate the contribution. The factors that affect quality include:

➔ Integrity of map collection data, whether there is GPS information, DeMR Tile information, POI auxiliary information, etc.

➔ The authenticity of the map collection, whether it is spam, attack data, duplicate data, forged data, sensitive data, etc.

➔ Image clarity, resolution, fields of view, number of effective features, etc.

➔ The time of collection, weather conditions, light conditions, day or night, rainy or sunny, etc.

➔ Angle of the image, whether the perspective is the same as the MR experience with a flat view coverage, etc.

➔ Occlusion of the image, whether there are a lot of invalid occluded areas in the image, etc.

➔ Collection of calibration data, whether matching with the original image data, etc.

In addition to the factors for the raw data, there are following factors arising from intermediate processing:

➔ Richness and accuracy of the annotated data

➔ Success and reconstruction quality of the map

➔ The success rate and efficiency of relocation during map validation

### 3.5.1 DeMR DCC

Contributors with different levels of proficiency may have a greater impact on map quality results and the subsequent review and reconstruction process, thus DeMR Network introduces the DCC (DeMR Contributor Credit) system, which is an important credibility value for contributors. The DCC system is tied to each user account (instead of NFT), and each user has an DCC index, and contributors with high DCC gain higher revenue efficiency, greater revenue range and even unlock the permission to sell.

The DCC accumulation improvement process can be slow, but if a contributor's work involves multiple instances of poor quality or fake data given negative feedback by the review process, the DCC will decrease quickly. Working with a skilled trainer allows novice contributors to quickly improve their DCC.

### 3.5.2 Pipeline Fee

The direct effect of contributors with low DCC is an increase in workload in Pipeline. Therefore, DeMR will automatically deduct Pipeline Fee from the map scanner. Well-trained contributors can get 90% or more of the incentives, but contributors with low DCC may only get 30% or less of the incentives.

However, the Pipeline Fee is used to pay the incentive to the reviewers in the follow-up process, and the reviewer's work also determines the quality of the map, thus the whole system is balanced. At the same time, reviewers have their own DCC, and DeMR will determine that reviewers with lower DCC cannot complete the review work independently, and will assign the task to trainers or other reviewers, which means that the incentive will be shared.

The only way to have the opportunity to complete tasks independently and receive a high percentage of incentives is to improve your DCC diligently.

# 4 Tokenomics

## 4.1 Token Brief

DeMR Network adopts a dual-token model, including: DMR (DeMR Network Token) and DDC (DeMR Data Credits).

### 4.1.1 DMR

DMR is a utility token used for DeMR Network governance and other functions. The total number of tokens is fixed at a maximum of 100 billion, and the rules for allocation are described in Section 4.3. DMR tokens are used for the following main purposes:

1) DAO Governance: DMR holders can initiate DeMR governance proposals and participate in community voting

2) Mining reward: Motivating all DeMR map contributors to build and maintain the data and network of DeMR HD map

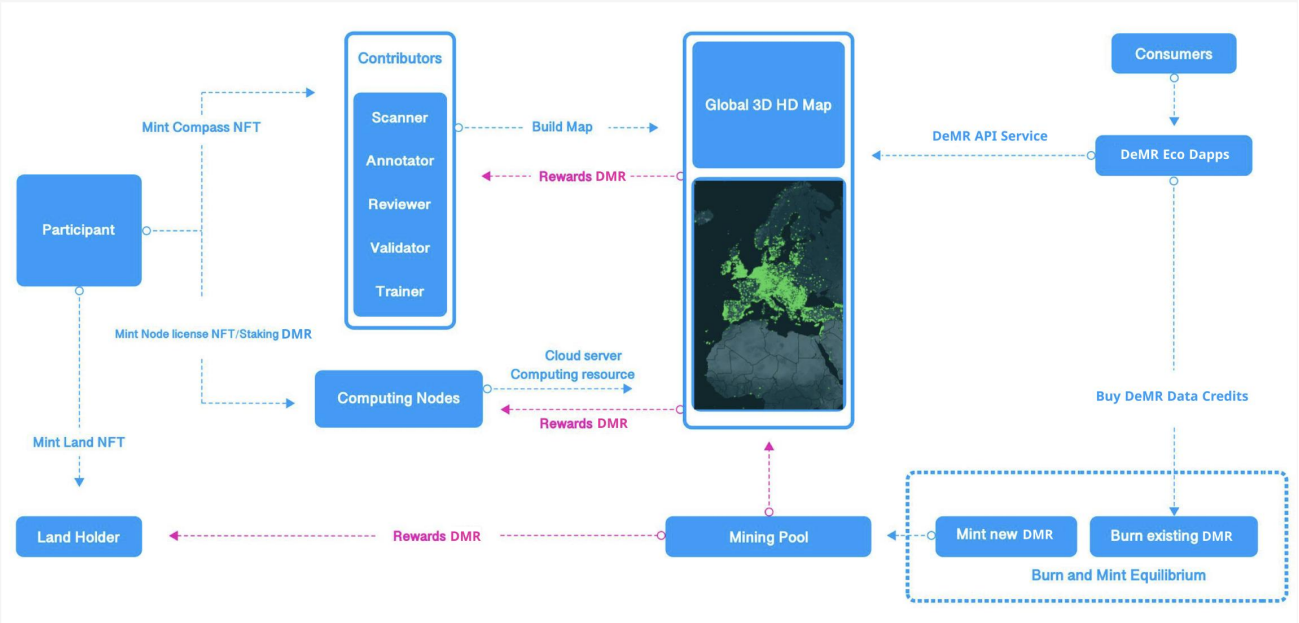
3) Node staking: DeMR network Computing Nodes need to stake DMR tokens to maintain Node License NFT qualification

4) Access to services: Developers burn DMR tokens to generate DDC to pay for the services used by DeMR maps

### 4.1.2 DDC

DDC is a kind of service fee for using DeMR map data, which is a fixed price traffic credit measured in stable coin, for example, 1 DDC is priced at $0.0001. DeMR has a internel transaction fee payment system, when a DAPP developed based on the DeMR API Services interface needs to call any map data in DeMR, the DAPP needs to pay the API services fee in the form of DDC. DDC is generated by burning DMR tokens at a conversion rate, DCC is irreversible and cannot be used for transferring or circulating in the secondary market, but can only be used by the original address to pay the related fees. The wallet address corresponding to the eco-application must keep enough DDCs to ensure the normal payment of the API Services Fee.

## 4.2 Economy Flow




As shown in the left part of the economy flow diagram, DeMR eco-participants can obtain the corresponding role identity by minting different types of NFTs under certain conditions (e.g., a large amount of DMR needs to be staked to become a computing node), and the main roles are divided into Contributors, Computing Nodes and Land Holders. Minting Compass NFTs allows you to become map creator, participating in the creation process of the Global MR HD Map, and receiving DMR token rewards from the mining pool. By minting Node License NFTs, users will become DeMR Computing Nodes and provide calculating and cloud server resources for the creation of Global MR HD Map, and then be rewarded with DMR tokens from the mining pool. Users may also become DeMR Land Holders by minting DeMR Land NFT, and when the map data is used by DeMR's ecological DAPPs in Global MR HD Map, the Land holders who hold the corresponding maps will be rewarded with DMR tokens from the mining pool.

As shown in the right part of the economic flow chart, DeMR provides various types of API services for ecological DAPPs. When consumers access any map data of Global MR HD Map through DeMR's ecological DAPPs, DAPPs need to pay in the form of DDC API Service Fee. DDC is generated by burning DMR and according to the current exchange rate of DDC and DMR.

## 4.3 Token Allocation

The total number of DMR tokens is fixed at a maximum of 100 billion, and the detailed allocation ratio and release rules are shown in the table below:

| | | |
|---|---|---|
| Contributors Airdrop | 3% | Unlocked |
| Liquidity | 5% | Unlocked |
| Investors | 10% | 10% released at the initial launch, remaining released every 3 months linearly for 36 months |
| Founding Team | 12% | 10% released at the initial launch, remaining released every 3 months linearly for 36 months |
| Marketing | 2% | Unlocked |
| Infra Delivery | 8% | 10% released at the initial launch, remaining released every 3 months linearly for 36 months |
| Treasury | 20% | Locked, with subsequent usage determined by DAO governance. |
| Mining Pool | 40% | Mining |

The tokens in the Mining Pool part are mainly used to motivate map contributors, computing nodes and Land Holders. The minting rate decreases by up to 50% every two years, it is almost certain that the minting rate will slow down as it is driven by the map progress.

## 4.4 Burn & Mint Equilibrium

The Burn & Mint Equilibrium creates an on-chain marketplace between the product creator and the consumer. Consumers buy and destroy tokens to obtain goods and services - in DeMR's case, collected map data, or the ability to set priorities for upcoming map data collections. Specifically, the mechanism enables them to purchase and destroy DMR tokens, and the system generates DDCs for them. As customers use their system DDCs, the system tracks their map usage in order to assign relevant rewards to specific Land Holders, map contributors, and computing nodes.

If the demand for network data usage is getting high, and the number of tokens destroyed by consumers per unit of time is greater than the number of tokens minted in that time period, there is a positive price pressure on the tokens, when a fixed number of DMRs will be redeemable for more DDCs, which will cause the system to gradually return to equilibrium; and vice versa.

Given that tokens are burned over time, and we don't want to deplete the supply of tokens in the system, we will use the Capped Net Emissions model, which means that the burned net amount of tokens will be used as mintable tokens for rewards to Land Holders and added back to the mining pool supply. However, this will not lead to a change in the maximum supply of tokens: the net release of tokens is to make up for the additional minting demand caused by the burning demand when the supply cannot meet the demand due to the halving rule, which means dynamically adjusted according to the number of map data visits per unit time. The entry of new tokens into the system will reduce the deflationary effect to a certain extent. Obviously, the normal operation of the system and the sufficient incentives for the contributors are more important. Eventually, there will be 2 billion tokens in permanent circulation in the system.

The release amount of tokens is a variable (due to the restriction on the maximum supply by the halving rule, it is not a constant). Before the Net Emissions model is activated, the release amount has no functional relationship with the destruction brought by the generation of DDC. The Net Emissions model will subsequently be activated as the demand for network usage increases and token releases are halved each year, so that contributors can continue to receive their rewards. We will dynamically adjust the maximum Net Emissions limit per unit of time-based on actual demand and through a vote initiated by the Governance Board, in order to meet the rewards for contributors without unduly weakening the deflationary effect of the original model. When demand continues to increase and exceed the maximum limit on net releases, the BME model will activate again and create a deflationary effect.

Complemented by the burn and mint equilibrium model and net emission rules, the number of recycled tokens will increase as customer demand increases. The network will continue to generate substantial rewards for contributors in perpetuity, and the available amount of value will ultimately be closely tied to the value paid by customers.

# 5 DeMR DAO

DeMR is an open ecology. DeMR will gradually liberalize the governance, use decentralized governance and economic system to determine DeMR's future ecological application direction, and so on. Users can participate in DeMR DAO to vote on which city's plot scanning will be opened in DeMR ecologies, such as New York, Singapore, Tokyo, Paris, etc., or vote on the governance of the DeMR ecological economic system, etc. As the DeMR ecology becomes well established, the role of DAO governance in the development of the DeMR world will also become increasingly important.

# 6 Road Map