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Blockchain, smart contracts, Web3 using AWS Building blocks

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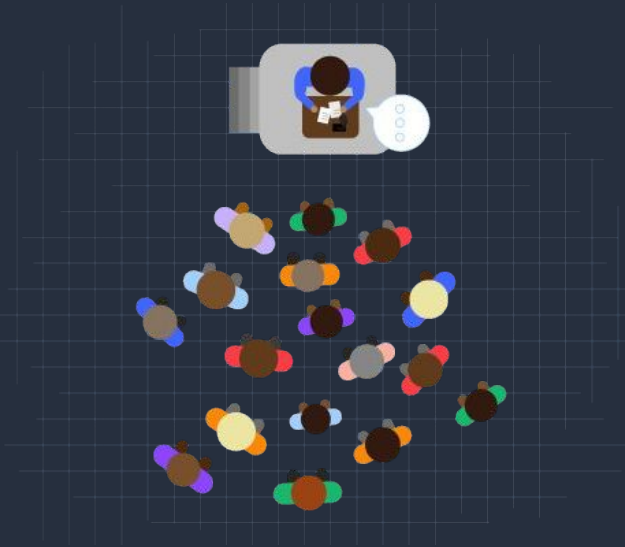
Agenda

- Blockchain components
- Why smart contract
- What is smart contract
- usecases of smart contract
- Solidity for smart contract
- Steps to create smart contract
- Advantages of smart contract
- AWS for Blockchain and Reference Architectures
- Web 3.0
- Demo of IDE



Blockchain components

Blockchain components

- Smart contracts
- Consensus mechanism
- Distributed ledger

Permissioned/Private Blockchain
Permissionless/Public Blockchain

PoW, PoS, PoA, pBFT
(Practical Byzantine Fault tolerance) - async

Centralized (QLDB) vs Decentralized trust

https://andersbrownworth.com/blockchain/blockchain

ETH2, Scalability issue, Expensive (Gas fee)
Beakon chain, sharding, docking, side chains, Layer 2

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Why smart contract

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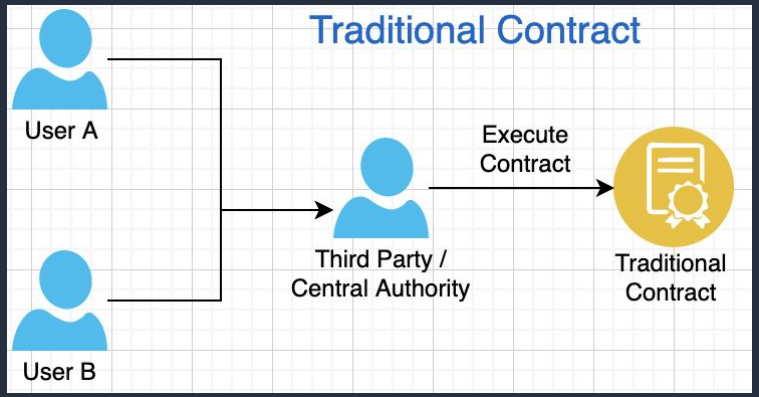
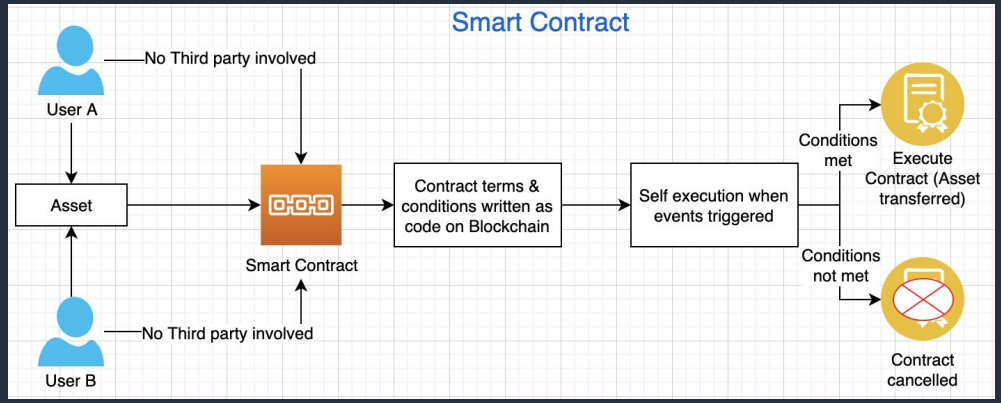
Why smart contract

Features	Traditional Contract	Smart Contract
Third Party	Government intermediatories, Laywers etc	None
Execution Time	Days	Minutes
Signature	Manual	Digital Signature (PKI)
Transparency	Unavailable	Available
Remittance	Manual	Automatic
Security	Limited	Cryptographically secured
Cost	Expensive	Low cost





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What is smart contract

What is smart contract

- Smart contracts are self-executing contracts containing terms and conditions of agreement between peers
- Smart contracts work by following simple “if/when…then…” statements that are written into code on a blockchain.
- A network of computers executes the actions when predetermined conditions have been met and verified
- Smart contract can be programmed by a developer – although increasingly, organizations that use blockchain for business provide templates, web interfaces, and other online tools to simplify structuring smart contracts
- Sample conditions and events
  - releasing funds to the appropriate parties
  - registering a vehicle
  - sending notifications
  - issuing a ticket

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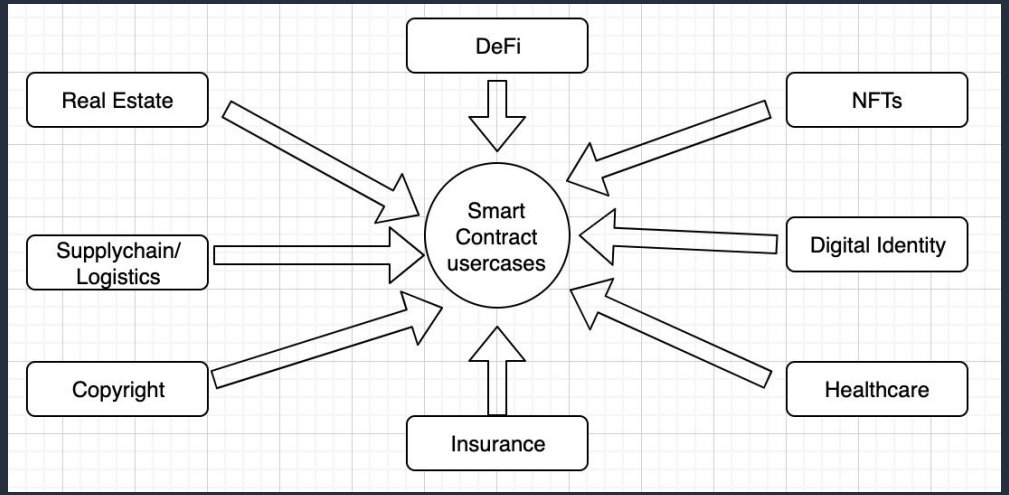
Use cases of smart contract

Use cases of smart contract (Private and Public)

- Flight Insurance - when flight is late by 3 hours, credit to customer automatically
- Voting for proposal - say dividend or any company resolutions
- Own currency for blockchain
- Supply chain, International trade finance
- Real estate
- NFT marketplace
- CBDC - Central Bank Digital Currency
- Supply chain management and Track and Trace
- Digital Ids/Vaccine certs



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Solidity for smart contract

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Solidity for smart contract

- Languages – Solidity, Vyper, Cadence
- Solidity compilers - solc (C++ compiler) or solcjs (npm)
- https://soliditylang.org/
- https://docs.soliditylang.org/en/latest/solidity-by-example.html
- https://github.com/ethereum/solidity
- ERC721 (NFTs), ERC20 (fungible tokens) or ERC1155(for Fungible and NFT) and use OpenZeppline based base implementation in the .sol contract

Sample code

```
function putPlotUpForSale(uint index, uint price) public {
        Plot storage plot = plots[index];
        require(msg.sender == plot.owner && price > 0);
        plot.forSale = true;
        plot.price = price;
        emit PlotAvailabilityChanged(index, price, true);}

function buyPlot(uint index) public payable {
        Plot storage plot = plots[index];
        require(msg.sender != plot.owner && plot.forSale && msg.value >= plot.price);
        if(plot.owner == 0x0) {
            balances[owner] += msg.value;
        }else {
            balances[plot.owner] += msg.value;
        }
        plot.owner = msg.sender;
        plot.forSale = false;
        emit PlotOwnerChanged(index);}
```

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Steps to create Smart contract

Select the IDE

- Cloud9 or EC2 with Visual Studio + Remote-SSH plugin
- Remix
- Truffle + Ganache CLI (Truffle – IDE, Ganache – Blockchain simulator, Drizzle – frontend for Truffle)
- Hardhat

-Select the Solidity version for e.g. pragma solidity ^0.8.17

-Compile the code (Bytecode is generated)

-Useful Truffle commands:

- npm install –g truffle, truffle version, truffle init, truffle compile, truffle test, truffle deploy, truffle console, truffle migrate –reset –network Gorellitestnet

Test the code locally

- Remix Daemon
- Truffle -> Ganache CLI
- Hardhat
- Test thoroughly as you cannot change the code later

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Where to deploy

-Select where to deploy the Smart Contract –

- Ethereum (Main or TestNet) or
- Binance (Main/Test net) or
- Hyperledger Fabric

- Ethereum Mainnet
- Ethereum Testnet (Sepolia and Goerli), (Ropsten and Rinkeby deprecated) https://ethereum.org/en/developers/docs/networks/
- Create your own node or use Amazon Managed Blockchain with Ethereum or Hyperledger Fabric – full node
- You get Contract address

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Interact with smart contract

- If you want to interact with Smart Contract use clients like Parity (Rust), Geth (Go), pythereum(Python)
- JSON RPC libraries – Web3.js or console like Drizzle
- Externally Owned Account (user) and Contract Accounts (Smartcontract)
- Etherscan or bscscan to verify the contract
- To invoke API services such as Alchemy, Etherscan, Infura get API Key
- For Mainnets get the tokens – Ether, Binance Coin (BNB) – gas fees (get from faucet), not for Hyperledger
- Integration with Hierarchical Deterministic (HD) wallet like Metamask

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Summary of steps

- Cloud9 or EC2 with Truffle and Ganache CLI or Local Blockchain (hardhat) or Remix IDE
- Create Amazon Managed Blockchain node for Ethereum Mainnet or Ethereum Testnet (multiple sync options)
- Alternatively create a node connector or use Alchemy / Infura
- create account
- create new application
- select environment (stage)
- select chain (Ethereum)
- select network (Goerli)
- API Key
- Metamask for Ethers
- Create account
- Send Ethers to Testnet
- Grab Private key from Metamask

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Advantages of smart contract

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Solidity for smart contract

- Trustless, Trackable and Transparent
- Speed, Efficiency, Accuracy
- Irreversible
- Security
- Cost Savings

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AWS for Blockchain and Reference architectures

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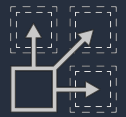
Amazon Managed Blockchain

Fully managed service that helps to create and manage scalable blockchain networks using popular open source frameworks: **Hyperledger Fabric** & **Ethereum**

Fully managed
Create a blockchain network in minutes

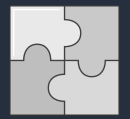
Open-source variety
Support for two frameworks

Decentralized
Democratically govern the network



Reliable and scalable
Backed with Amazon technology

Low cost
Only pay for resources used



Integrated
Easily use with AWS services

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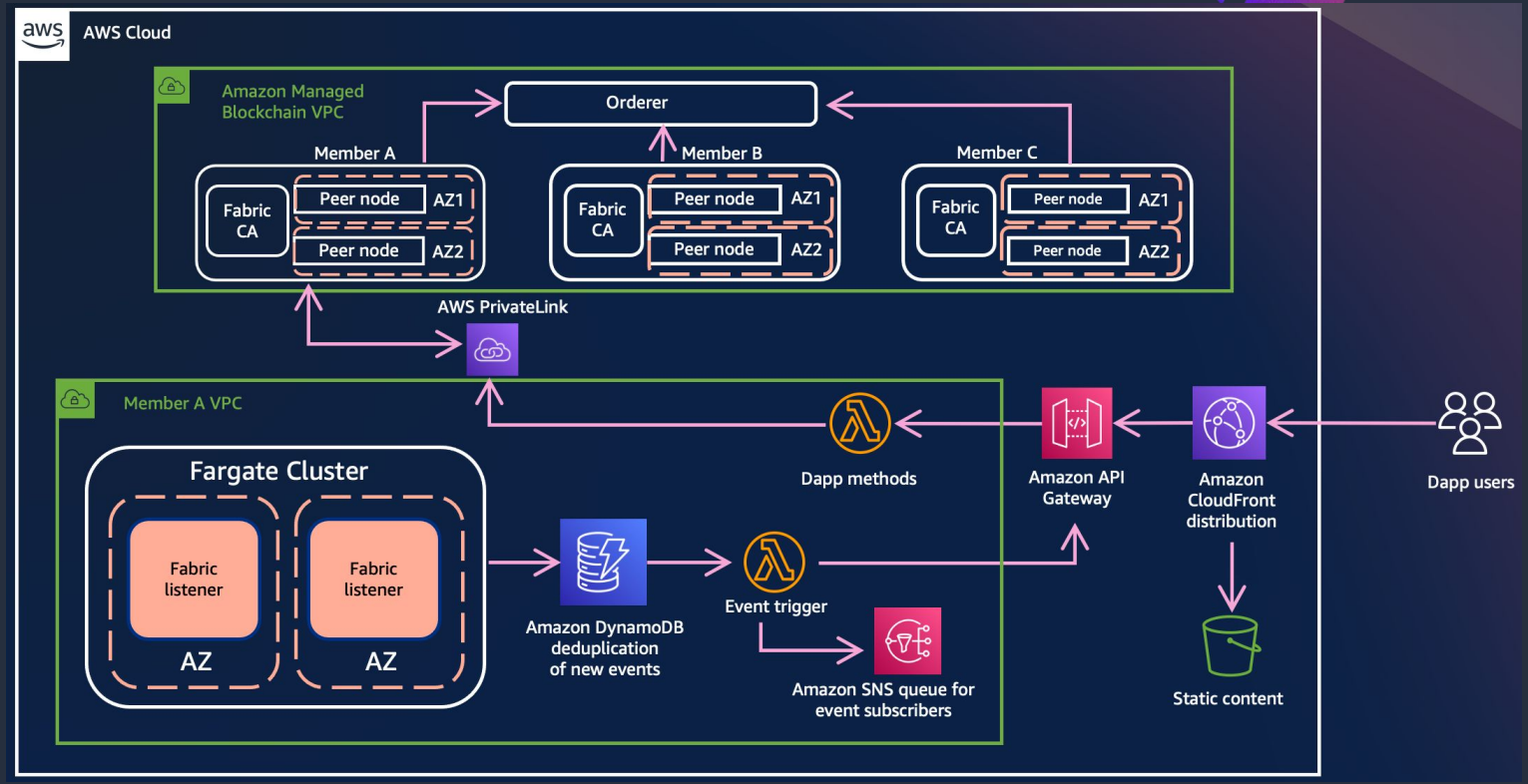
Reference architecture – Hyperledger Fabric dapp



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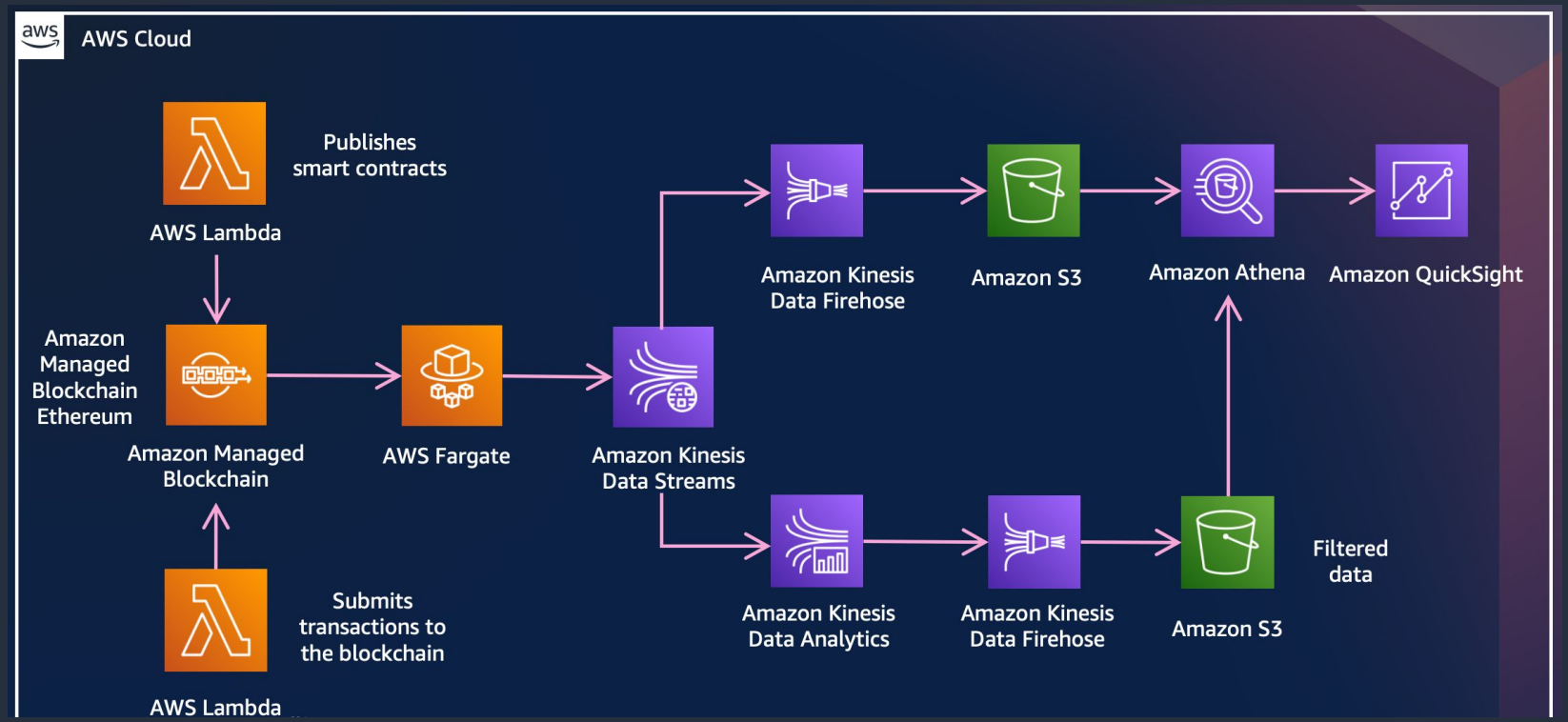
Reference architecture – Ethereum dapp



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Hosting a blockchain node on AWS

DESCRIPTION

Blockchain nodes are critical to the decentralized structure of Layer 1 and Layer 2 blockchains. They sustain and secure the blockchain by storing a copy of the decentralized ledger and performing certain functions to validate the legitimacy of transactions.

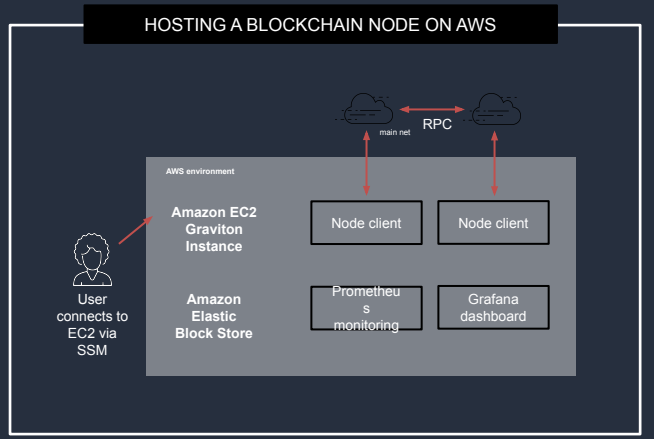
AWS provides more than 275 instance types to optimize cost and performance to fit your specific nodes requirements. Companies can easily host a blockchain node on AWS and delegate it for on-chain activities including staking and analytics.

USE CASES

Layer 1 & 2 | Staking-as-a-service | On-chain analytics | Lower latency access

RELEVANT SERVICES

- Amazon EC2
- AWS Nitro Enclaves
- AWS Key Management Services
- AWS CloudHSM



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Securing blockchain key management with AWS Nitro Enclaves

DESCRIPTION

There are architectural challenges and limitations to operate low-level tasks and manage access to private keys on public blockchains.

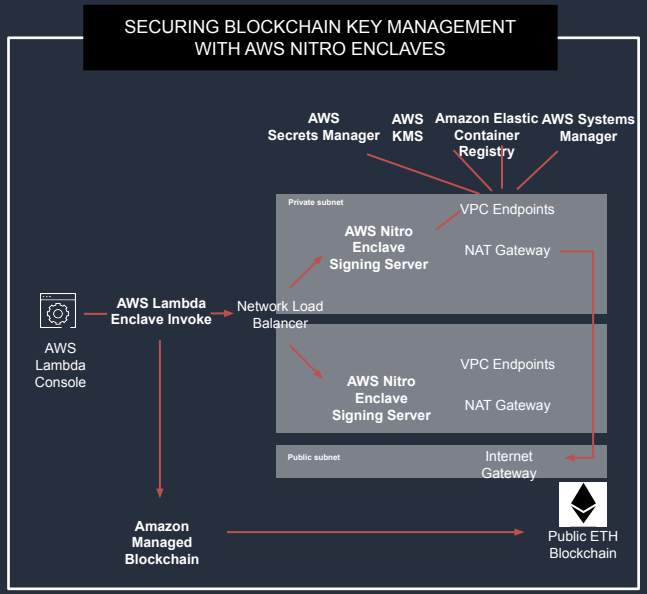
AWS Nitro Enclaves offers flexible support for low-level blockchain operations such as scaling out key management in a secure fashion.

USE CASES

Layer 1 & 2 nodes | Wallet-as-a-service | Custodians

RELEVANT SERVICES

- AWS Nitro Enclaves
- AWS Key Management Services
- AWS Secrets Manager
- AWS PrivateLink
- AWS Firewall Manager



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Scaling blockchain applications through serverless infrastructure

DESCRIPTION

Developing Web3 infrastructure comes with evolving challenges, especially managing the backend system and applications at scale.

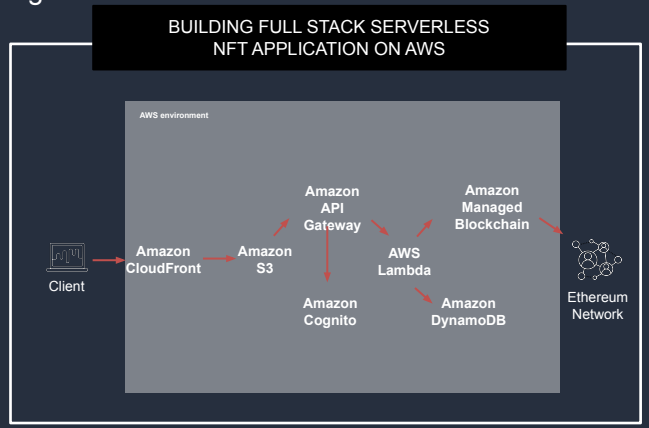
AWS serverless architecture enables seamless scaling by taking away the heavy lifting of infrastructure maintenance so you can focus on building what matters the most.

USE CASES

NFT minting | Token metadata | Web3 marketplaces | On-chain analytics

RELEVANT SERVICES

- AWS Lambda
- Amazon CloudFront
- Amazon API Gateway
- Amazon DynamoDB
- AWS Fargate



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Indexing, managing, and processing large volumes of data securely

DESCRIPTION

Off-chain data and computation are important to inform on-chain business insights and strategic decisions.

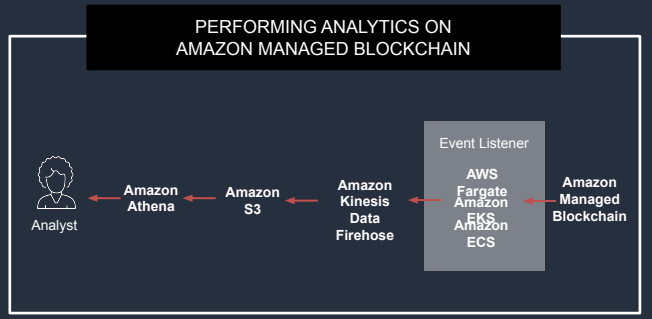
AWS Data Lakes and Analytics solutions make it easy to index, manage, and process large volumes of data off-chain for downstream analytics in a cost-effective and scalable approach.

USE CASES

Digital asset markets | CeFi/DeFi | Off-chain analytics | On-chain event monitoring

RELEVANT SERVICES

Amazon S3 | Amazon EMR | Amazon API Gateway | AWS Glue | Amazon Athena



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Web 3.0

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AWS powers BUIDLers across Web3

LAYER 3
Application

LAYER 2
Smart Contracts
Scalability
Efficiency

LAYER 1
Consensus
Compute

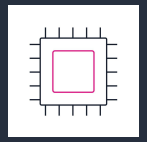
LAYER 0
Networking

DeFi | NFTs | Metaverse | GameFi

Layer 2 Blockchains

Infrastructure | Dev Tools | Identity | Privacy & Security | Analytics | DAO | Wallets...

Layer 1 Blockchains



Processor | Memory | Nodes | Validators | Mining

Interoperability | SDKs

Exchanges

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BUIDLing blocks for Web3 & Blockchain companies on AWS

CORE COMPUTE & INFRASTRUCTURE

CORE

Compute
- Amazon EC2
- Amazon EC2 Spot

Serverless
- AWS Lambda
- AWS Step Functions
- Amazon EventBridge

Containers
- Amazon ECS
- Amazon EKS

IoT
- AWS IoT

SECURITY

- AWS Nitro Enclaves
- AWS Secrets Manager
- AWS KMS
- AWS Cloud HSM
- AWS Cognito

STORAGE SYSTEMS & API

API/NETWORK

- Amazon API Gateway
- AWS AppSync
- Amazon CloudFront
- AWS PrivateLink
- AWS Direct Connect

STORAGE SYSTEMS

Storage
- Amazon S3
- Amazon EBS

Databases
- Amazon DynamoDB
- Amazon ElastiCache
- Amazon RDS

Observability
- Amazon Managed Prometheus
- Amazon Managed Grafana
- Amazon Container Insights

MACHINE LEARNING & ANALYTICS

- Amazon Kinesis
- Amazon Managed Streaming for Apache Kafka (MSK)
- Amazon SageMaker

MANAGED BLOCKCHAIN & LEDGER DATABASE SERVICES

- Amazon Managed Blockchain
- Amazon Quantum Ledger Database

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Reference blogs and usecases

Reinvent 2022 video - Broadridge Financial Solutions

Amazon Managed Blockchain – all blogs

Track and Trace workshop

NFT Marketplace Github link

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Questions ?

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Thank you!

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